We will be the best at getting better!

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A playbook for population health improvement

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Abstract

For transforming organizations and communities, the San Francisco Department of Public Health, Population Health Division has embraced *population health lean*—a transdisciplinary management system for learning, adaptation, innovation, and continuous improvement based on the Toyota Production System (lean), collective impact and other methods. Our training focus is on lean thinking and practice. Our values include *respect for people* (dignity, equity, compassion, and humility) and *continuous improvement* (challenge, "go and see" to understand, *kaizen*, and teamwork).

Keywords

population health, quality improvement, lean, lean startup, collective impact, design thinking, decision science

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Our mission and vision

To protect and promote health and well-being for all in San Francisco.

Making San Francisco the healthiest place on earth!

Contents

1. Introduction

Humans, in pursuit of goals, use cognitive-behavioral processes—**reasoning**, **deciding**, **acting**, and **learning**—that are influenced by *sensory input* and **intuition** (feelings [affect] and emotions) [1, 2], and that form the basis for all human activities. *Adaptation* comes from adjusting our decisions and actions based on what we learn. *Improvements* are adaptations that make things better.

Learning organizations embrace and promote

- **positive and safe environments** (esp. psychological safety)
- **performance improvement** (better processes and results)
- **decision intelligence** (management science + data science)
- **strategic execution** (implementation science + project mgmt)
- **critical reasoning** (causal, evidential and scientific reasoning)

Population health is "a systems framework for studying and improving the health of populations through collective action and learning" [3]. *Lean practice* is "systematically developing people to solve problems and consuming the fewest possible resources *while* continuously improving processes to provide value to community members and prosperity to society" [4]. *Population health lean* (PHL) is a transdisciplinary management system for continuous learning, adaptation, improvement, and innovation based on lean thinking and practice, the PHL leadership philosophy, and complementary frameworks (Figures 1 and 2).

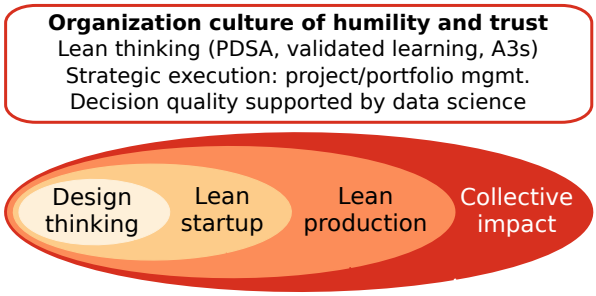


Figure 1. Population health lean human-centered approach

2. Leadership philosophy

The leadership philosophy (Figure 2) is a framework to promote and support lean (a) values, mindset (principles), skillset, and toolset; (b) behaviors; (c) people development; (d) scientific problem-solving; (e) daily management; and (f) leading change.

(a) Values, mindset (principles), skillset, and toolset

Values

We have four types of **values** (Figure 2, p. 2): *personal values* (What's important to you?), *organization values* (What's important to us?), *customer value* (What's important to our primary customers?), and *measurement values* (How do we measure values? How do we measure controllable predictors of value?). **Universal values** are transcendent and apply to everyone, everywhere [5].

The lean value pillars are *respect for people* and *continuous improvement*. **Respect for people** includes the universal values of (a) humility, (b) compassion, (c) equity (fairness), and (d) dignity [5]. **Continuous improvement** includes (a) challenge (need, problem, opportunity, goal, assignment), (b) "go and see" to understand (*genchi genbutsu*), (c) *kaizen*, and (d) teamwork.

Humility, dignity, equity, and compassion are universal core values that drive radical, transformative change [5]. "Humility is the noble choice to forgo your status, [and to] use your influence for the good of others before yourself" [6]. Humility fuels the *growth mindset* [7], promoting courage, feedback, and growth.

Mindset (Shingo guiding principles: www.shingoprize.org/model)

Principles drive behaviors (culture), systems change, and results.

1. Respect every individual (see lean value pillars above)
2. Lead with humility (i.e., intellectual and cultural humility)
3. Seek perfection (and embrace mistakes to learn and grow)
4. Embrace scientific thinking (PDSA ↔ daily experiments)
5. Focus on process (deciding, executing, learning, connecting)
6. Assure quality at the source (life course, social determinants)
7. Flow and pull value (meet customer demand, eliminate waste)
8. Think systemically (including socioecological health model)
9. Create constancy of purpose (with unwavering clarity)
10. Create value for the customer (human-centered designed results: "How well did we do it?" and "Is anyone better off?")

Skillset

The population health lean skillset includes core skills and methods that drive problem-solving, experimentation, learning, adaptation, innovation, and improvement. Traditional lean production [8–10] is strengthened by integrating methods from complementary frameworks (design thinking, lean startup, Results-Based Accountability,™ etc.). However, *we recommend focusing on skills 1 to 4*, especially "NewSmart" behaviors and lean thinking, and developing other skills as needed ("learning in the work").

1. Staff exhibit **"NewSmart" behaviors** (see Section 5 on p. 8)
2. Staff as daily **scientific problem-solvers** (Figure 2)
3. Managers are **practitioner-coaches** (Figure 2)
4. **Lean thinking** (PDSA, validated learning, A3 reporting [11])
5. Collective impact (results-based) methods [12, 13]
6. Lean production [14], lean startup [15], design thinking [16]
7. Decision quality [17] and agile project management [18]

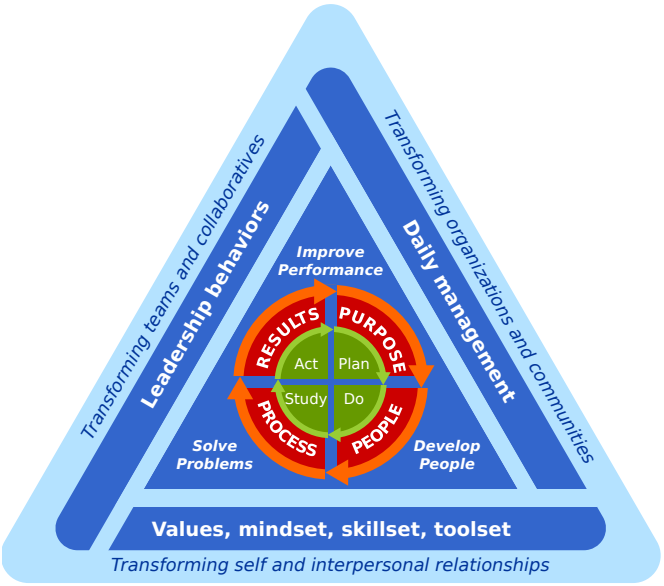


Figure 2. Population health lean leadership philosophy

Toolset

Population health lean emphasizes lean production and management tools for leadership, people development, continuous improvement, strategic planning and strategy deployment, visual management, project management, and ensuring team accountability at all levels:

1. Catch-ball (dialogue, feedback, shared decision making)
2. 5S (workplace organization for visual management) [19]
3. Standard work (including leader standard work) [20, 21]
4. Value-stream mapping (eliminate waste; optimize flow) [22]
5. Status reports (monitor); performance huddle boards [20]
6. *Hoshin kanri* [23]; *kanban* agile project management [18]
7. 3P ("production preparation process") for new designs

(b) Leadership behaviors

"Leadership is getting results in a way that inspires trust" [24]. Lean behaviors are observable actions that communicate *intent* (what), *motive* (why), and *agenda* (how: who, when, and where). "Public health leadership is the practice of mobilizing people, organizations, and communities to effectively tackle tough public health challenges" [25]. The PHL **leadership behaviors** include

(a) leader standard work that
(b) aligns to values, principles, and purpose, and that
(c) deploys scientific thinking and problem-solving.

(c) People development

Standard work "is the agreed-upon, best-known, least wasteful way of doing the work today until a better way is found." Adhering to standard work requires discipline. Starting with self, **leader standard work** is "developing people to solve problems and improve performance" by deploying the PHL leadership philosophy. This includes a personal visibility board with a schedule of daily, weekly, and monthly activities such as *gemba* walks, huddles, coaching, teaching, training, and *kaizen* workshops.

(d) Scientific problem-solving

Scientific problem-solving is using scientific thinking [26] with Plan-Do-Study-Act (PDSA) cycles for planning, predicting, experimenting, learning, and improving. Throughout we deploy causal, evidential and probabilistic reasoning, ethical principles, and economic concepts to inform, influence, or optimize decision-making, priority-setting, and resource allocation (covered in the sections ahead).

(e) Daily management system

The lean transformation of an organization requires a culture that supports daily scientific thinking, problem solving, creativity, experimentation, innovation, accountability, and performance improvement. A daily management system (DMS) enables, aligns and improves the lean leadership philosophy at the team level.

Our DMS consist of five interdependent components:

(a) standard work (sets baseline for training and improvement),
(b) visual management (shared understanding/accountability),
(c) tiered reporting (strategic alignment and communication),
(d) team huddles (problem solving and improvement), and
(e) staff development (lean leadership philosophy).

(f) Leading radical, transformational change

Figure 3 depicts the **Leading Population Health Framework** (LPHF). Using a socioecological, community-centered, life course, multi-generational approach, essential LPHF goals include:

(a) protecting and promoting equity and health,
(b) transforming people and place,
(c) ensuring a healthy planet, and
(d) achieving health equity.

The LPHF includes at least four interdependent domains:

(a) population health lean leadership philosophy,
(b) transforming self and interpersonal relationships,
(c) transforming teams and collaboratives, and
(d) transforming organizations and communities.

Figure 4 on the following page depicts the expanded LPHF.

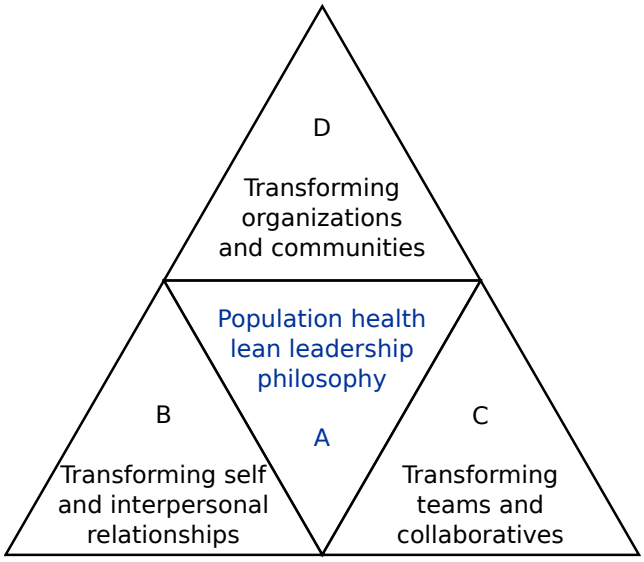


Figure 3. The Leading Population Health Framework

A. Population health lean leadership philosophy

Again, the lean leadership philosophy is a framework to promote and support lean (a) values, mindset (principles), skillset, and toolset; (b) behaviors; (c) people development; (d) scientific problem-solving; (e) daily management; and (f) leading change.

B. Transforming self and interpersonal relationships

Transforming self and interpersonal relationships requires competencies in thinking, deciding, connecting, and leading. At center is the core human processes of intuition (feelings and emotions), reasoning, deciding, acting, and learning. Decisions are central because they transform intuition, reasoning and learning into action. Connecting is building positive, healthy relationships based on universal values (dignity, equity, compassion, and humility), trust, and courage. Humility includes cultural humility.

Critical thinking requires *intellectual humility* (see p. 8). W. Edwards Deming's System of *Profound knowledge* is the understanding of (a) systems (systems thinking), (b) people (human psychology), (c) variation (statistical thinking), and (d) theory of knowledge creation (i.e., PDSA). *Strategic intelligence* is (a) having foresight, (b) building a shared vision, (c) building effective partnerships, and (d) motivating and inspiring people [27, 28].

Embodying universal values, *radical transformational leadership* (RTL) is being, designing, and leading change to transform self, people, systems, and cultures towards equity and sustainable results [5]). RTL is a values-based, servant leadership model for transforming self and others, and shifting systems and cultural norms towards sustainable equity. RTL uses the Conscious Full-Spectrum Response for problem-solving, solution design, and monitoring transformation (see p. 13).

C. Transforming teams and collaboratives

Transforming teams and collaboratives requires competencies in building teams, solving problems, and achieving impact. Core skills include lean thinking (scientific thinking, PDSA problem-solving, validated learning, and A3 reporting). Teams must learn to build trust, engage in constructive conflict, make good decisions, be accountable, and manage affective conflict. Teams deploy problem-solving and solution design approaches such design thinking, lean startup, lean production, Results-Based Accountability,™ and collective impact.

D. Transforming organizations and communities

Transforming organizations requires designing humble, healing, and learning organizations. Transforming communities requires engaging and partnering with communities using established approaches, including the Spectrum of Prevention,[1] Community Action Model [29], and Conscious Full-Spectrum Response [5].

In pursuit of our population health goals we deploy *data science*—the art and science of transforming data into information and actionable knowledge. The foundation of data science is *population health thinking*—core competencies in probabilistic (statistical) reasoning, causal inference, and decision quality [30].

The LPHF uses teams as innovation laboratories for continuous experimentation, learning, improvement, and transformation.

[1] See https://cchealth.org/prevention/spectrum/

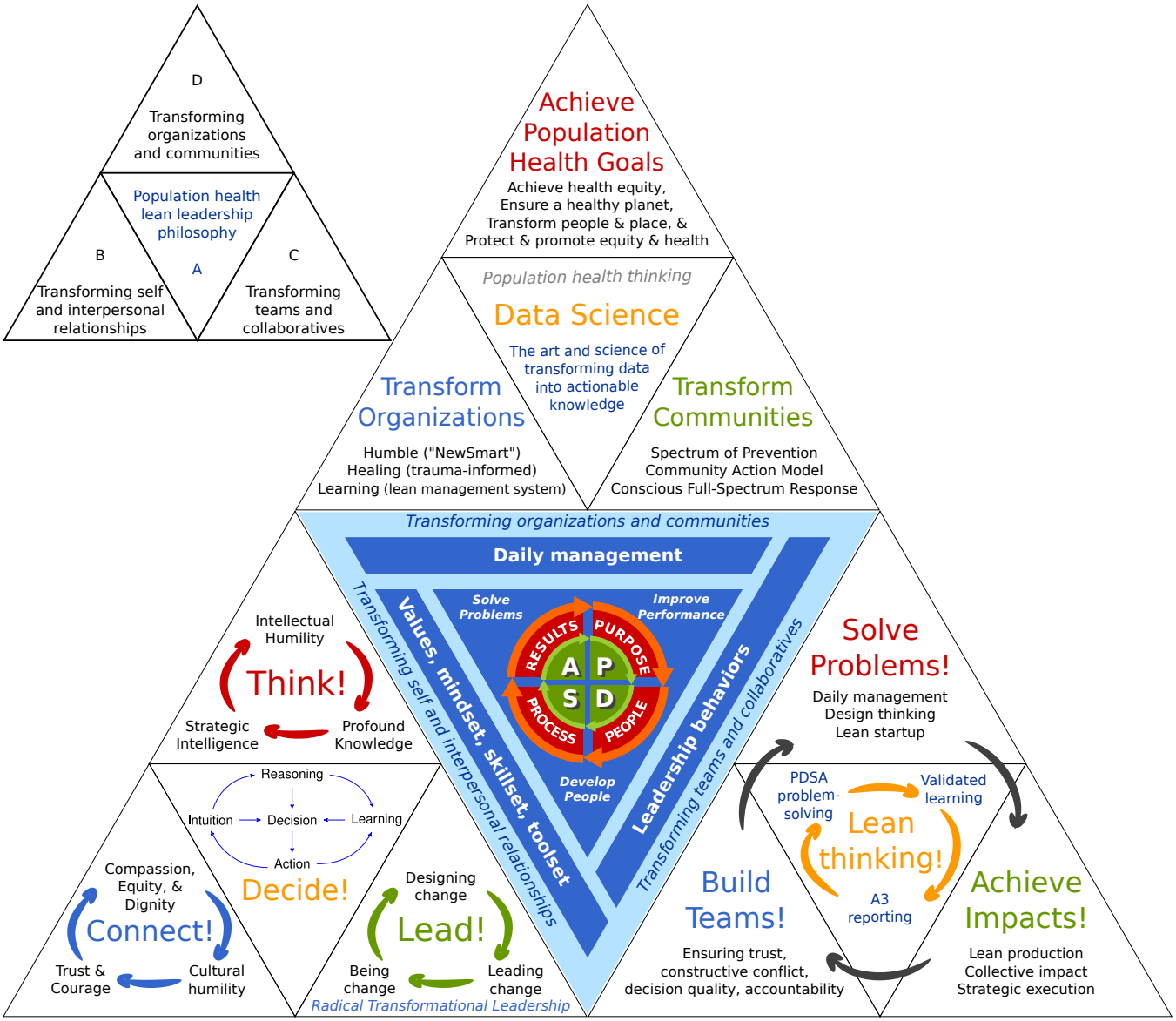


Figure 4. The Leading Population Health Framework (LPHF) uses teams as focused laboratories for problem-solving, experimentation, learning, improvement, and transformation. The foundation of LPHF is humility, and transforming self and interpersonal relationships.

3. The role of public health systems

Health is "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" [31]. **Public health** is "what we, as a society, do collectively to assure the conditions in which people can be healthy" [32].

Health disparities are "differences that exist among specific population groups in the United States in the attainment of full health potential that can be measured by differences in incidence, prevalence, mortality, burden of disease, and other adverse health conditions" [33].

Health equity is "the state in which everyone has the opportunity to attain full health potential and no one is disadvantaged from achieving this potential because of social position or any other socially defined circumstance" [33].

Health inequity arises from root causes in two clusters:

1. "Intrapersonal, interpersonal, institutional, and systemic mechanisms (also referred to as structural inequities) that organize the distribution of power and resources differentially across lines of race, gender, class, sexual orientation, gender expression, and other dimensions of individual and group identity.
2. The unequal allocation of power and resources—including goods, services, and societal attention—which manifests itself in unequal social, economic, and environmental conditions, also called the determinants of health" [33].

The Public Health System

"**Public health systems** are commonly defined as 'all public, private, and voluntary entities that contribute to the delivery of essential public health services within a jurisdiction.' This concept ensures that all entities' contributions to the health and well-being of the community or state are recognized in assessing the provision of public health services."[2]

"The public health system includes:[2] (a) public health agencies at state and local levels, (b) health care providers, (c) public safety agencies, (d) human service and charity organizations, (e) education and youth development organizations, (f) recreation and arts-related organizations, (g) economic and philanthropic organizations, and (h) environmental agencies and organizations."

The 10 Essential Public Health Services

The 10 Essential Public Health Services describe the public health activities that all communities should undertake, and is often led by the public health system (defined above) (Figure 5):[2]

1. **Monitor health status** to identify and solve community health problems
2. **Diagnose and investigate** health problems and health hazards in the community
3. **Inform, educate, and empower** people about health issues
4. **Mobilize community partnerships** and action to identify and solve health problems
5. **Develop policies and plans** that support individual and community health efforts
6. **Enforce laws and regulations** that protect health and ensure safety
7. **Link people to** needed personal **health services** and **assure the provision of health care** when otherwise unavailable
8. **Assure competent** public and personal health care **workforce**
9. **Evaluate effectiveness, accessibility, and quality** of personal and population-based health services
10. **Research for new insights** and innovative solutions to health problems

Public Health Accreditation Board Standards (domains)

Health departments often mobilize the public health system, and many have been accredited based these national standards.[3]

1. **Assess:** Conduct and disseminate assessments focused on population health status and public health issues facing the community
2. **Investigate:** Investigate health problems and environmental public health hazards to protect the community
3. **Inform and educate:** Inform and educate about public health issues and functions
4. **Community engagement:** Engage with the community to identify and address health problems
5. **Policies and plans:** Develop public health policies and plans
6. **Public health laws:** Enforce public health laws
7. **Access to care:** Promote strategies to improve access to health care
8. **Workforce:** Maintain a competent public health workforce
9. **Performance improvement:** Evaluate and continuously improve processes, programs, and interventions
10. **Evidence-based practices:** Contribute to and apply the evidence base of public health
11. **Administration and management:** Maintain administrative and management capacity
12. **Governance:** Maintain capacity to engage the public health governing entity

Figure 5. The 10 Essential Public Health Services

[2] http://bit.ly/cdc-ph-system

[3] http://www.phaboard.org/

4. PHD True North Compass

Up to now we have covered content that is directed to population health organizational leaders. Now we cover what key concepts that are branded and promoted across the organization. We call this our **True North Compass** (TNC). The TNC has six components:

(a) values,
(b) principles (mindset),
(c) true north metrics,
(d) customers,
(e) mission (or purpose), and
(f) vision.

Figure 6 depicts how the components of the TNC can be organized from the bottom up into a triangular structure. The values and principles are the foundation of the TNC structure and are the most important components. Here is the bottom line:

If you could only focus on one thing, focus on values!

Values

Values were introduced on p. 2. The lean value pillars are respect for people and continuous improvement. For *respect for people* we recommend organizations adopt universal values. The core "universal values that anchor equitable and sustainable transformation in our work are dignity, equity, compassion, and humility—all emanating from our inherent oneness. By universal we mean that these values apply to all human beings, with no one left out anywhere. These universal values are not culturally determined, and they transcend religious tenets, norms, and other social diktats. Dignity, equity, compassion, and humility are [core] universal values" [5]. At SFDPH PHD, we always start with humility (intellectual humility, cultural humility, racial humility). Humility is a profound concept requiring deep, lifelong commitment and critical self-reflection, as we will read in the sections ahead.

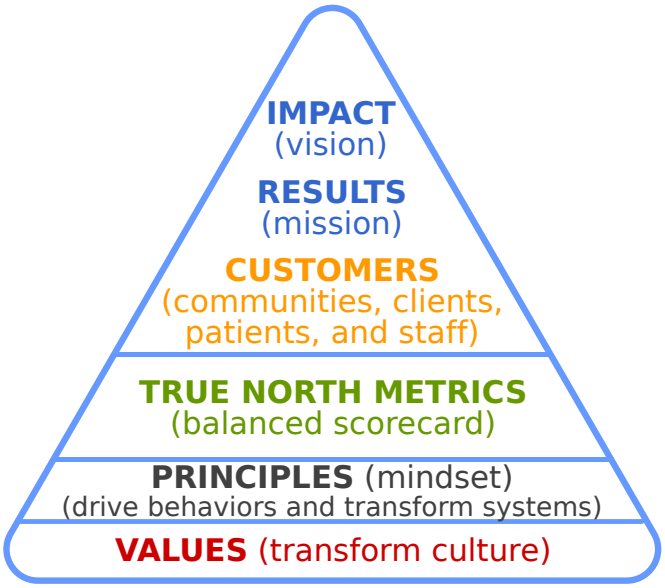


Figure 6. Lean True North Compass components

Principles (mindset)

Values can lead to competing objectives and trade-offs. Ethics is the use of deliberative, transparent frameworks to weigh value trade-offs and make ethical decisions. In contrast, principles are "laws for thinking"—a mindset—that drive decisions, learning, and behaviors in every situation. Principles are very powerful! We have adopted the **Shingo Model™ Guiding Principles**[4] (listed on p. 2). They can be grouped into the following themes:

1. Enable: cultural enablers,
2. Improve: continuous improvement,
3. Align: enterprise alignment, and
4. Results (see true north metrics).

For results, ask "How well did we do?", "Is anyone better off?"

True north metrics

Similar to a balanced scorecard used in business enterprises,[5] our true north metrics are seven dimensions of measurement priorities shared across every level of the organization, and into the community:

1. Equity,
2. Health impact,
3. Workforce,
4. Safety and Security,
5. Financial stewardship,
6. Service experience, and
7. Decision quality (transform data into good decisions).

"Decision Quality" (DQ) is continuous decision improvement based on established requirements for making good decisions (see Section 15 on page 42). Data science—the art and science of transforming data into actionable knowledge—supports DQ.

While PHD has strategic initiatives in all truth north directions, across SFDPH, including PHD, we are working on aligned organizational strategic initiatives involving equity, workforce, and data science.

Customers

Primary customers include communities, clients, patients, and staff. Other important customers include governing bodies, policy makers, agency directors, funding agencies, and state and federal partners.

Mission (or purpose)

The mission is what we do and the high-level results we aim for. The **SFDPH mission** is "To protect and promote the health and well-being for all in San Francisco."

Vision

The vision is the aspirational impact we desire for our organization and for San Francisco. The **SFDPH vision** is "Making San Francisco the healthiest place on earth."

PHD True North Compass

Displayed in Figure 7 on the following page is the Population Health Division True North Compass.

[4] http://www.shingoprize.org/model
[5] http://www.balancedscorecard.org/

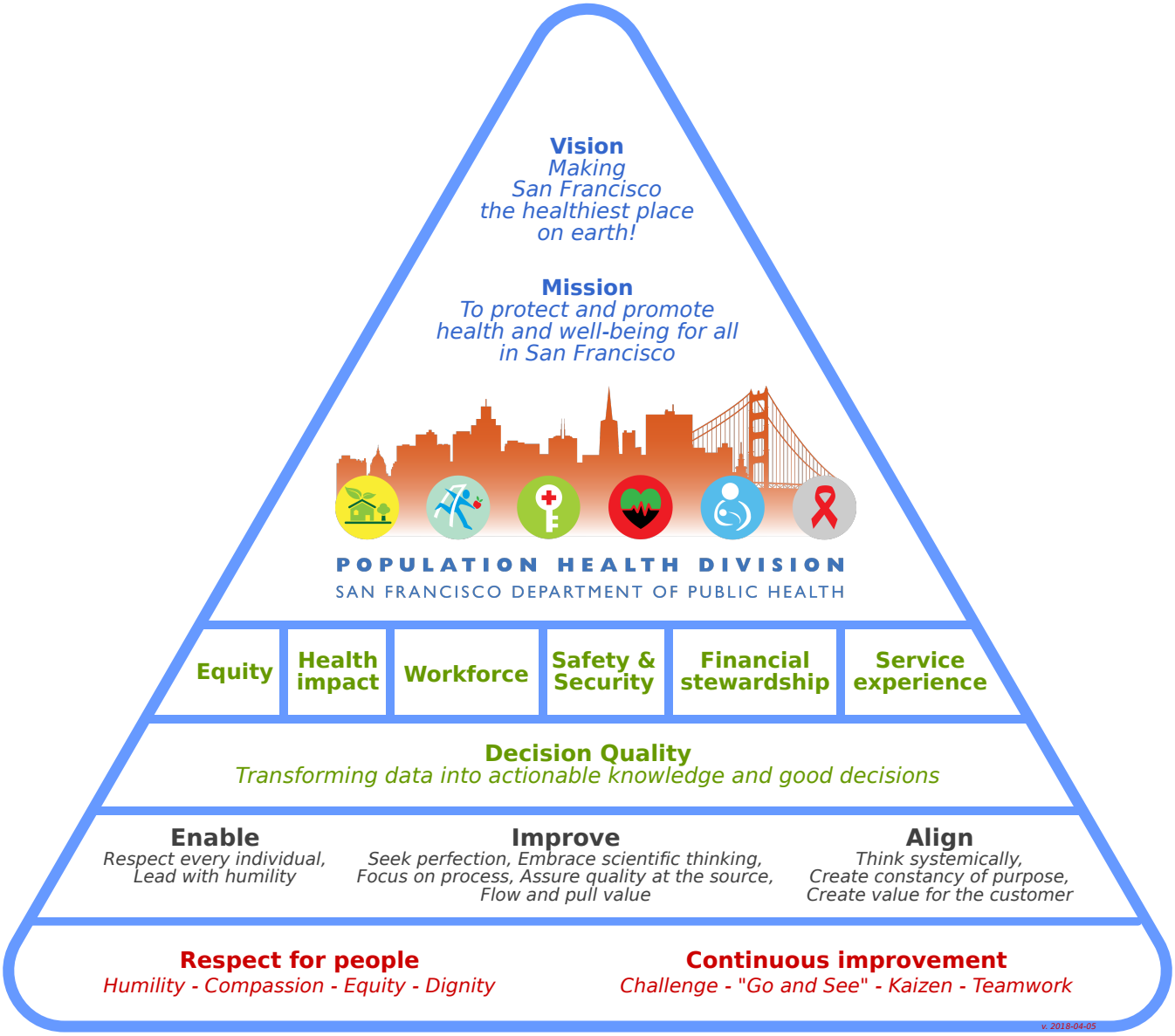


Figure 7. Population Health Division **True North Compass**, San Francisco Department of Public Health. **Population health** is a systems framework for studying and improving the health of populations through collective action and learning. **Lean practice** "is systematically developing people to solve problems and consuming the fewest possible resources while continuously improving processes to provide value to community members and prosperity to society." Level 1 has the lean value pillars (respect for people and continuous improvement). Based on **universal values**, we respect others by embodying humility and compassion, and promoting equity and dignity. *The embodiment and promotion of universal values transforms culture*. Level 2 has the **Shingo Principles**. Principles are human "laws" for thinking (mindset) that always apply: they guide decisions, drive behaviors, and transform systems. The **True North metrics** (Levels 3 and 4 in green) represent our "balanced scorecard" to promote holistic organizational and community health improvement that aligns with and supports our mission and vision. Our key TN metric is "Health Impact." Influenced by Results-Based Accountability,™ population health lean includes **Results Thinking**: *How much did we do? How well did we do it? Is anyone better off?* "Decision Quality" (DQ) is continuous decision improvement using best practices and good information. DQ is supported by **population health data science** (PHDS)—the art and science of transforming data into information and actionable knowledge that informs, influences or optimizes decisions and actions that protect and improve population health (defined above).

5. Humility is the new smart!

Our world is changing fast! Automation, machine learning, and artificial intelligence—the Smart Machine Age (SMA)—are disrupting and displacing the workforce. Transdisciplinary teamwork is the new norm. People skills, creative and critical thinking, innovation, and improvement are more important now than ever!

Unfortunately, our native cognitive abilities have not evolved at the same pace [34]. Our brain is wired to sense "dangers" and react based on perceived threats and emotions. Our brain is wired for efficiency: it defaults to personality traits, fast decisions via nonconscious schemas or learned mindsets. We resist new ideas that demand new cognitive effort. Our decisions are suboptimal due to *cognitive biases* (see p. 18): (a) protection of mindset, (b) personality and habits, (c) faulty reasoning, (d) automatic associations, (e) relative thinking, and (f) social influences [17].

Human are prone to *defensiveness* from our innate drive to *protect our ego* (self-concept) and to *avoid our fears* (vulnerability, uncertainty, risk, intellectual or emotional exposure, uninvited scrutiny). Science shows these behaviors impede creativity, critical and innovative thinking, reflective listening, and emotionally engaging others [35]. We can mitigate these biases using brain science. We start with a new definition of "being smart" ("NewSmart"). We must embrace intellectual humility, honesty, and courage and redesign organizations for this new age. Professor Edward Hess' **NewSmart Humility** has four interdependent components: (a) NewSmart principles, (b) Humility mindset, (c) NewSmart behaviors, and (d) NewSmart organization [35].

(a) Intellectual humility (part 1): The "NewSmart" principles

"To change our mental model for the SMA," Hess writes, " we first need to accept a quality-based definition of 'being smart'—a NewSmart—that we define as excelling at the highest level of thinking, learning, and emotionally engaging with others that one is capable of doing. NewSmart is a measure not of *what* you know or *how much* you know but of (a) the quality of your thinking, listening, collaborating, and learning; (b) how good you are at "not" knowing and decoupling your beliefs (not values) from your ego; (c) how good you are at being open to continually stress-testing your beliefs about how the world works; (d) how good you are at trying out new ideas and ways to accomplish your objectives and learning from those experiments" [35].

"So what does the high-quality thinking, learning, and emotional engagement underlying NewSmart look like in practice?" The **NewSmart principles** are worth committing to memory:

1. "I'm defined not by what I know or how much I know, but by the quality of my thinking, listening, relating, and collaborating."
2. "My mental models are not reality—they are only my generalized stories of how my world works."
3. "I'm not my ideas, and I must decouple my beliefs (not values) from my ego."
4. "I must be open-minded and treat my beliefs (not values) as hypotheses to be constantly tested and subject to modification by better data."
5. "My mistakes and failures are opportunities to learn."

Table 1 compares the "old smart" to the NewSmart.

Table 1. Comparison of "old smart" versus NewSmart

Old smart	NewSmart
I know	I'm good at not knowing
I tell	I ask
Defend my views	Improve my views
Seek confirmation	Seek truth
Close mind	Open mind
Insecure if beliefs are challenged	Insecure if beliefs are NOT challenged
Mistakes are bad	Mistakes are learning opportunities
Perfectionism	Learning

(b) Intellectual humility (part 2): The Humility mindset

We embrace two definitions of humility: (a) Dickson defines humility as "the noble choice to forgo your status, [and to] use your influence for the good of others before yourself" [6], and (b) Hess defines "Humility as a mindset about oneself that is open-minded, self-accurate, and 'not all about me,' and that enables one to embrace the world as it 'is' in the pursuit of human excellence" [35].

"Humility is a mindset that results in not being so self-centered, ego defensive, self-enhancing, self-promotional, and closed-minded—all of which the science of learning and cognition shows inhibit excellence at higher-order thinking and emotionally engaging with others" [35].

(c) The NewSmart behaviors

The NewSmart and Humility mindsets drive behaviors that are supported and improved with evidence-based skills. Hess clusters them into four behavioral categories:

(i) **Quieting Ego**,
(ii) **Managing Self** (one's thinking and emotions),
(iii) **Reflective Listening**, and
(iv) **Otherness** (emotionally connecting and relating)

(i) Quieting Ego

"Quieting Ego is how we can deliberately work to reduce our reflexive emotional defensiveness; have empathy and open-mindedness; engage in Reflective Listening; and proactively seek other people's feedback and perspectives to stress-test our own thinking. Quieting Ego is a way of practicing and operationalizing Humility. To quiet our ego is to perceive others and the world without filtering everything through a self-focused lens and to tamp down on negative or self-protective 'inner talk' that is driven consciously or subconsciously by our fears and insecurities" [35]. Quieting Ego starts with four evidence-based behaviors: (a) mindfulness, (b) mindfulness meditation, (c) daily Quiet Ego reminders, and (d) practicing gratitude.

(ii) Managing Self (one's thinking and emotions)

"Managing Self—our emotions and thinking—aids us in engaging in the higher-level thinking and behavior required .... It's nec-

essary to remain open-minded and be willing to test our beliefs and modify our points of view if presented with better data. It's also how we're able to overcome our fear of mistakes in order to take ownership of them and learn from them, and helps us more effectively relate to and collaborate with others" [35].

"Managing Self comes from the science of 'self-regulation' and 'self-control,' which are broad psychological concepts that mean to monitor and manage one's emotions, thoughts, and behaviors" [35], and start with these practices: (a) slowing down, (b) managing thoughts, (c) managing emotions, and (d) emotional intelligence.

For managing thoughts, Hess' "thinking toolbox" starts with familiar concepts from population health lean (PDSA problem-solving, root cause analysis, etc.). We recommend reading Richard Nisbett's *Mindware: Tools for Smart Thinking* [36].

For managing emotions, "We've discussed how ego and fear are the two big learning inhibitors and explored our reflexive tendency as humans to be emotionally defensive and self-protective. We've discussed how negative emotions can undermine our behavior and thinking and how positive emotions can improve them. Stress, anger, and anxiety can cause narrow-mindedness and the fight-flee-or-freeze syndrome. … Positive emotions, on the other hand, have been scientifically linked not just to higher health and well-being but also to broader attention, open-mindedness, deeper focus, and more flexible thinking, all of which underlie creativity and innovative thinking. Positive emotions also improve decision making and general cognitive processing."

Hess' "managing emotions toolbox" includes effective techniques such as (a) psychological distancing, (b) reframing, (c) positive memories, (d) positive self-talk, and (e) if-then implementation plans. See Hess book [35] for illustrative examples.

Emotional intelligence (EI) is "the ability to monitor one's own and others' feelings and emotions, to discriminate among them and to use this information to guide one's thinking and actions. … Sensitivity to other people's emotions has been found to be a key to effective collaboration." The EI model includes these abilities (read "Emotional Intelligence Needs a Rewrite" [37]):

1. *Perceive and differentiate emotions* in self and others.
2. *Use emotions* to facilitate reasoning, aid judgment and memory processes, problem solve, communicate with others, and facilitate open-mindedness.
3. *Understand emotions* by analyzing the emotions of yourself and others.
4. *Manage emotions* in self and others.

Please read Lisa Feldman Barrett's *How emotions are made* [2].

(iii) Reflective Listening

"Reflective Listening is so important because it underlies all [other skills]. Why? Because your thinking and learning are limited by cognitive biases, emotional defensiveness, ego, and fear. You need, then, to truly listen to others to open your mind, push past your biases and mental models, and mitigate self-absorption in order to collaborate and build better relationships. [We know from] evidence that it's hard for any of us to critique our own thinking and truly think critically. We're just too wired to confirm what we already believe, and we feel too comfortable having a cohesive simple story of how our world works. We need to have thinking 'partners' who force us to confront those biases, and we need to listen to them" [35].

Reflective Listening includes these practices: (a) preparing to listen reflectively, (b) listening with a Quiet Ego and an open mind, and (c) humble inquiry (asking with humility and genuine curiosity). Here's a preparation checklist for Reflective Listening:

1. Is my mind clear? If not, take several deep, slow breaths.
2. Am I calm emotionally? If not, take a few more deep breaths, focusing on breathing in for four seconds and very, very slowly breathing out for four seconds.
3. Say to yourself a couple of times: (a) "I am not my ideas." (b) "It's not all about me." (c) "Don't be defensive." (d) "Ask questions before telling." (e) "Don't interrupt." (f) "Stay focused." (g) "Critique ideas, not people." (h) "Listen to understand, not to confirm."

(iv) Otherness (emotionally connecting and relating)

Hess writes "We need others because we can't think, innovate, or relate at our best alone. To relate to other people you first have to make a connection with them. It is by building a relationship over time that you build trust, and when you have caring trust, you have set the stage for the highest level of human engagement. … So how do you get better at connecting and relating? It's quite obvious that connecting and relating to people is inhibited by arrogance, self-absorption, self-centeredness, not listening, closed-mindedness, lack of empathy, emotional defensiveness, and the ego protection and fear that flow from the Old Smart mental model. Accepting NewSmart and Humility as well as practicing Quieting Ego, Managing Self, and Reflective Listening lays the groundwork for relationship building with others."

Otherness behaviors include: (a) using the fives keys to connecting, (b) building trust and conveying caring (p. 10), (c) preparing for meetings, (d) choosing words wisely. The five keys to connecting are (a) be present, (b) be genuine, (c) communicate affirmation, (d) listen effectively, and (e) communicate support.

Prepare for meetings with this checklist: (a) be *really* present; (b) genuinely smile—a big smile; (c) make eye contact; (d) be positive; (e) listen reflectively; (f) stay *fully* present; and (g) do no harm. Choose your words wisely: use "Yes, and" instead of "Yes, but" to build on the ideas of others; use "I believe" instead of "I think" to acknowledge your ideas are hypotheses open to critique and testing; use "I want to" instead of "I have to" and "I won't" instead of "I can't" to emphasize the power of choice.

(d) NewSmart organization

Finally, design your organizational culture and environment for learning, adaptation, innovation, and improvement leveraging established psychological concepts: (a) **positivity** (promote positive emotions, minimize negative emotions); (b) **self-determination theory** (promote intrinsic motivation by supporting innate human drives for autonomy, relatedness, and competence); and (c) **psychological safety** (feeling safe to speak freely; to experiment, fail, and learn; to seek and give constructive feedback; to challenge others' thinking, including the "boss") [38]. Humility and leading with humility is at the heart and mind of population health lean!

6. Building effective teams

Today, teams must be agile, adaptive, responsive, and improving. High-performing population health teams master the following:

1. sourcing humility, compassion, and equity (fairness)
2. building trust and celebrating courage
3. ensuring self and team accountability
4. managing "crucial conversations"
5. enabling constructive conflict

Embodying cultural humility

In 1998, Melanie Tervalon and Jann Murray-García published a groundbreaking article [39] that challenged the concept of "cultural competency" with the concept of "cultural humility." **Cultural humility** is committing to lifelong learning, critical self-reflection, and personal and institutional transformation. Accepting cultural humility means accepting that we can never be fully culturally competent. Cultural humility is the foundation for establishing trust and respectful relationships, and for managing differences and conflict. Cultural humility means

1. committing to *lifelong learning* and *critical self-reflection*;
2. realizing your **powers**, **privileges**, and **prejudices** (biases) (includes conscious and nonconscious [implicit] biases);
3. redressing *power imbalances* for *respectful partnerships*; and
4. promoting *institutional accountability*.

Power is "the capacity or ability to direct or influence the behavior of others or the course of events." Power comes from positional, moral, or relational authority. Authority is granted by appointment, earned by trust and credibility, or exercised by persuasion, manipulation, or deceit. The dynamics and impacts of power are multi-dimensional, context dependent, cumulative, and can be subtle. For example, a vocal boss can unintentionally shut down subordinates. Be aware and mindful of power imbalances.

Privilege is a form of unearned power that comes from social advantage. Privilege exists because of sociopolitical systems and cultural norms that create, reinforce, and amplify power inequities, explicitly or implicitly (nonconscious). For example, in the U.S., if you are male, heterosexual, cisgender, or have lighter skin color you have more privilege. You do not choose privilege, but you can acknowledge it, and, more importantly, you can make "the noble choice to forgo your status, [and to] use your influence for the good of others before yourself"—this is humility [6].

For our purposes, *biases* are preferences, cognitive processes, or inferences that shape our mental models, knowledge, attitudes, beliefs, and behaviors in ways that cause or contribute to inequities in power, privilege, opportunities, or outcomes for ourselves and/or others. Biases can be known to you and others (open), known to you and not others (hidden), known to others but not you (blind spot), or not known to you and others (unknown).

Implicit biases account for the unknown and blind spot biases, and are the most challenging type of bias because we all have them, and they are difficult to identify, measure, and mitigate. For example, ambiguous hiring criteria are susceptible to implicit biases. Without unambiguous, objective criteria, hiring someone you "trust" is driven, unintentionally, by implicit biases.

The 7 principles of building trust

In organizations with high trust levels staff engage in honest, vigorous deliberations about important and sensitive topics, including strategy, budget cuts, ethics, equity, racism, discrimination, power, privilege, prejudice, interpersonal conflict, etc.

The word trust is used often but rarely defined. The word is thrown around as if everyone understands exactly what we mean. We attend countless meetings where "building trust" is emphasized. Building and restoring trust requires a thoughtful, systematic approach. To understand trust we must define it precisely. Trust is an aspect of relationships; it varies within and across relationships. Organizational trust researcher, Roger Mayer, defines **trust** as follows [40]:

> "Trust is the willingness of a party [trustor] to be vulnerable to the actions of another party [trustee] based on the expectation that the other party will perform a particular action important to the trustor, irrespective of the ability to monitor or control that other party. . . . Making oneself vulnerable is taking a risk. Trust is not taking a risk *per se*, but rather it is a *willingness* to take risk."

In short, *trust is the willingness to be vulnerable to another party*. Therefore, trust is *a state of readiness to take risk in a relationship*. Trust is the willingness to *assume* risk; *behavioral trust* (or a trusting action) is the assuming of risk. Our focus is on trust as a state of readiness ("willingness"). *An organizational culture of trust is a culture where staff feel safe to tackle and vigorously debate the most challenging, sensitive topics in service of the organizational purpose*.

Not appreciated by many is that trust is a decision [41]. As an intuitive (gut) decision we experience trust as a *feeling of safety*. As an deliberative decision we experience trust as a *feeling of confidence*. In short, our objective is to influence others to trust us, our teams, and our organization. Therefore, our job as managers is (a) to be trustworthy, (b) to behave in ways that inspire trust, and (c) to design systems that promote a culture of trust.

Building a culture of trust inspires better team collaboration, decision-making, execution, accountability, and performance. Here is standard work for **Building Trust**—these behaviors apply always, with anyone, and in any situation: think "C3-HATS"

1. Have *character*: honesty, integrity, and loyalty
2. Be *caring*: embody humility and compassion; promote equity (fairness) and dignity; help others without expectations
3. Be *competent*: capable, consistent, continuously improving
4. Be *humble*: intellectual, cultural, and racial humility
5. Be *accountable*: own your influence; own your mistakes and failures, apologize and make amends, and keep commitments
6. Be *transparent*: communicate motive [why], intent [what], agenda [how: who, when, where], and (mutual) expectations
7. Ensure *safety* (psychological, physical): respect boundaries, listen, don't judge, assume good intent, and show vulnerability.

If you need a foolproof method to build trust immediately with someone (e.g., your boss as the potential trustor), try this: "It's really important to me that I earn your trust *and* confidence.

Please tell me *exactly* what you need from me." Ask for specifics and what success looks like. Write it down and review it with your potential trustor. Confirm mutual goals and expectations.

Do not confuse trust with *confidence*. Trusting someone is not equivalent to having confidence in them. Trust requires a risk of vulnerability. A corollary: earning others' complete trust almost always earns confidence in you, but earning others' confidence (e.g., in your abilities) does not mean they also trust you (i.e., willingness to be vulnerable to your actions).

The trustor's *propensity to trust* is the predisposition or general willingness to trust before any information about the trustee is considered. At one extreme, a very high propensity to trust can result in extending trust even when it is not warranted ("blind trust"). At the other extreme, a low propensity to trust can result in not extending trust even when it is warranted ("blind mistrust").

"Distrust" and "mistrust" have roughly the same meaning. Both mean lack of trust. But *distrust* is lack of trust based on experience or reliable information, while *mistrust* is often a general sense of unease toward someone or something.

Understanding empathy and compassion

With *sympathy* I care about your suffering. With *empathy* I feel your suffering. With *compassion* I want to relieve your suffering. Be aware and mindful: because of our implicit biases we are more likely to empathize with people "like us" (e.g., tribalism). Instead, we endeavor to have empathy for those unlike us, and to have compassion towards those who are vulnerable or suffering, and to act in the face of our vulnerabilities—this is courage.

Celebrating courage

Humility and trust are based in human relationships and involve vulnerability. Brené Brown defines **vulnerability** *"as uncertainty, risk, and emotional exposure."* "Vulnerability is the core of all emotions and feelings. To feel is to be vulnerable" [42]. *Any time someone risks vulnerability to get better, build trust, protect others, or behave ethically they are courageous!* Therefore, *we are surrounded by daily acts of unrecognized courage!* Recognize and celebrate our courageous staff, clients, and communities!

Promoting accountability

The Center for Creative Leadership defines accountability:

> Whereas *responsibility* is generally delegated by the boss, the organization, or by virtue of position, *accountability* is having an *intrinsic sense of ownership* of the task and the willingness to face the consequences that come with success or failure.

Accountable managers "look out the window to apportion credit . . . when things go well, [and] they look in the mirror to apportion responsibility . . . when things go poorly" [43]. In other words, *when failures occur, we actively seek full responsibility for anything we could have influenced*—we do not seek blame or look to "hold someone accountable"—we problem-solve and ask "how can I (or we) make things better?" Lean leaders promote a culture of trust, humility, and respect, and deploy a lean management system that engages and promotes accountability at all levels.

Managing conflict and consensus for team decisions

Constructive conflict[6] enhances shared understanding and consensus, improving decision quality (p 42) and implementation effectiveness. Constructive conflict is optimal when we (a) have *trust*, (b) ensure *cognitive diversity*, (c) minimize *affective (emotional) conflict*, and (d) maximize *cognitive conflict* [44].

Managing crucial conversations

Teams built on trust are high-performing: members engage in constructive conflict. However, *affective conflict* is unproductive and may be destructive to relationships and team performance. Patterson recommends engaging in a "crucial conversation" when we recognize affective conflict [45]: (a) *high stakes*, (b) *opposing opinions*, and (c) *strong emotions*.

We must recognize how our *cognitive*, *emotional*, and *behavioral* processes are tightly coupled but—ultimately—under our control through our awareness and management of self and others. In modified **Path to Action** (Figure 8), based on [1, 2], we have

1. *sensory input* from others' behaviors (their Path to Action)
2. *intuition* (feelings, emotions, affective realism, nonconscious)
3. *reasoning* (post-hoc moral reasoning vs. mindful reflection)
4. *acting* (based on intuition vs. mindfulness and deliberation).

For modern neuroscience and social psychology read [1, 2].

Figure 8 depicts the Crucial Conversions model. First, study and understand the model components. Second, study Table 2 on the next page. (If possible, read the book [45], but use modified Path to Action). Next, the Steps 1–3 are the most important:

1. Start with *heart* (know what you *really* want for you & others)
2. Learn to *look* (crucial conversation, safety, silence, violence)
3. Make is *safe* (ensure or restore safety to move forward)

Be aware that a crucial conversation can emerge quickly and unexpectedly. We must be mindful of our and others' emotions and the "story" that may be activating emotions. Be aware that our implicit (nonconscious) biases may be the cause. Note that the crucial conversation skills build upon your NewSmart behaviors (p. 8) that require mindfulness and emotional intelligence.

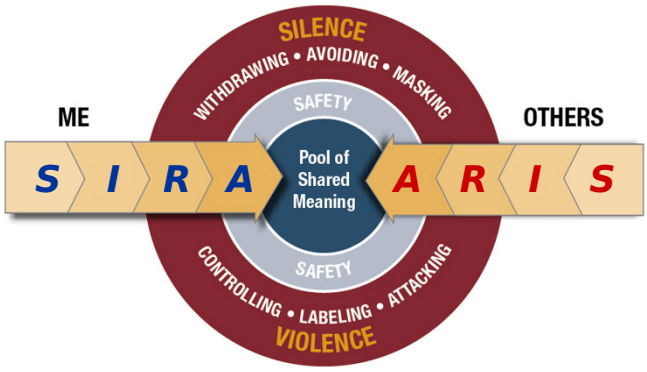


Figure 8. Crucial conversations: Focus on Paths to Actions: **S** is *Sensory input*, **I** is *Intuition* (nonconscious, System 1), **R** = *Reasoning* (conscious, System 2), and **A** is *Acting* (behaviors). Ensure emotional and physical safety, enlarging the **Pool of Shared Meaning** and shrinking circle of silence and violence.

[6] vigorous debate of ideas, concepts, strategies, decision trade-offs, etc.

Table 2. Coaching for Crucial Conversations (adapted from source: [45])

	Principle	Skill	Crucial question(s)
1	Start with heart	Focus on what you *really* want. Refuse the "Sucker's Choice." (false choice between "violence" or "silence.")	What am I acting like I really want? What do I *really* want? For me? For others? For the relationship? How would I behave if I really did want this?
2	Learn to look	Look for when the conversation becomes crucial. Look for safety problems. Look for your own Style Under Stress.	Am I going to silence or violence? Are others going to silence or violence?
3	Make it safe	Apologize when appropriate. Contrast to fix misunderstanding. CRIB to get to Mutual Purpose. - **C**ommit to seek Mutual Purpose - **R**ecognize the purpose behind the strategy - **I**nvent a Mutual Purpose - **B**rainstorm new strategies	Why is safety at risk? (a) Have I established Mutual Purpose? Be humble and always start with dignity, fairness (equity), and compassion (b) Am I maintaining Mutual Respect? (cultural humility) What will I do to rebuild safety?
4	Master my stories	Retrace my Path to Action. Separate fact from story. Watch for the Three Clever Stories. Tell the rest of the story.	What is my story? What I am pretending not to know about my role in the problem? Why would a reasonable, rational, and decent person do this? What should I do right now to move toward what I really want? (i.e., starting with dignity, equity, and compassion)
5	STATE my path	**S**hare your facts. **T**ell your story. **A**sk for others' paths **T**alk tentatively. **E**ncourage testing.	Am I really open to others' views? Am I talking about the real issue? Am I confidently expressing my own views?
6	Explore others' paths	**A**sk – **M**irror – **P**araphrase – **P**rime **A**gree – **B**uild – **C**ompare.	Am I actively exploring others' views? Am I avoiding unnecessary disagreement?
7	Move to action	Decide how you'll decide. Document decisions and follow up.	How will we make decisions? Who will do what by when? How will we follow up?

7. Radical transformational leadership

> *Leadership is getting results in a way that inspires trust. . . . Stephen M.R. Covey [24]*

Leaders are people that others follow [27, 28]. If no one follows, one cannot be a leader. *Leadership is a relationship*. Good leadership means people willingly follow a leader who is working to further the common good. Leadership is a relationship that cannot be handed off to anyone else. In contrast, management is a collection of functional tasks to carry out, monitor, and achieve strategic objectives. Unlike leadership, management functions can be delegated.

Global leadership scholar Roger Gill argues that leadership practice boils down to **six core themes of leadership** [46]:

1. *Values* (build on humility, compassion, equity, and dignity)
2. *Purpose* (Why do we exist?) (or *mission*: What do we do?)
3. *Vision* (What does the desirable future look like?)
4. *Strategy* (How will we get there?)
5. *Engagement* (involve stakeholders at every step)
6. *Empowerment* (provide training and tools to succeed)

According to the Oxford Dictionary *radical* is an adjective meaning "(especially of change or action) relating to or affecting the fundamental [root] nature of something; far-reaching or thorough." **Radical transformational leadership** (RTL) [5]

> *is being, designing, and leading change from the universal values of humility, compassion, equity, and dignity to transform self, people, systems, and cultures towards equity and sustainable results.*

Public health leadership—"the practice of mobilizing people, organizations, and communities to effectively tackle tough public health challenges [25]"—is radical transformation leadership. Our goal is root systems and cultural transformation to (a) protect and promote equity and health, (b) transform people and place, (c) ensure a healthy planet, and (d) achieve health equity.

The core "universal values that anchor equitable and sustainable transformation in our work are [humility,] dignity, equity, and compassion—all emanating from our inherent oneness. By universal we mean that these values apply to all human beings, with no one left out anywhere. These universal values are not culturally determined, and they transcend religious tenets, norms, and other social diktats. [Humility,] dignity, equity, and compassion are [core] universal values" [5].

First, I must commit to transformation with results. I must communicate with clarity and confidence [5]

(a) "What I stand for, the universal values I embody and manifest through my action."
(b) "The impact I wish to generate; [for example,] well-being for all and a thriving planet."

Next, who do I need to *be*, how do I need to *think*, and what do I need to *do* to create paradigm shifts? We have three categories: **being change** (the "contemporary pioneer"), **designing change** (the "unifying architect"), and **leading change** (the "mindful proactivist" and the "radical systems and cultural transformer").

Public health knowledge base and competencies

Before diving into radical transformational leadership, we review the core public health knowledge base and competencies. A competency is the "effective application of values, traits, knowledge, and skills in complex situations" [25].

Public health knowledge is prevention-focused, changing, transdisciplinary, value-laden, and mostly evidence-based. The *public health knowledge base* of public health leaders includes [25]:

- *Public health science*: analytic / assessment; basic public health sciences (data science, environmental health, health policy and management, social and behavioral sciences); cultural humility; communication; community dimensions of practice; financial planning and management; leadership and systems thinking; policy development and program planning
- *Understanding people*: motivation, and social and emotional intelligence
- *Understanding complex systems*: systems thinking, and complex adaptive social systems.
- *Changing people, organizations, and communities*: change management, culture of innovation, and positive deviance.

Applying knowledge without a holistic framework (Figure 9) can lead to fragmented, partial-spectrum interventions (Figure 10) and inequitable or unsustainable results. System interdependencies can lead to delayed, unpredictable, or unintended consequences.

The 25 core **public health competencies** can be grouped into five competency sets:

1. **Invigorate bold pursuit of population health**: assess the current state of your program or organization; articulate a compelling agenda; enlist others in the vision and invigorate them to drive toward it; pursue the vision with rigor and flexibility; and marshal the needed resources.
2. **Engage diverse others in public health initiatives**: assess local conditions, in ways relevant and credible to the local stakeholders; search widely for the right partners; apply a social determinants perspective to planning; take time to build relationships, teamwork, and common understanding; and clarify roles and governance.
3. **Effectively wield power to increase the influence and impact of public health**: understand and strategically use positional authority and informal influence; analyze public health problems and proposed solution in "campaign" terms; build coalitions of core supporters, new partners, and issue-specific allies; deal effectively with opponents; and be strategically agile.
4. **Prepare for surprise in public health work (e.g., disasters)**: promote resilience in individuals and communities; develop and critique an emergency response plan; communicate effectively during surprises; execute emergency response plans with flexibility; and learn and improve after surprises.
5. **Drive for execution and continuous improvement**: build accountability into public health teams; establish metrics, set targets, monitor progress, and take action; proactively demonstrate financial stewardship of public health funds; employ the methods and tools of quality improvement; and encourage innovation and risk-taking.

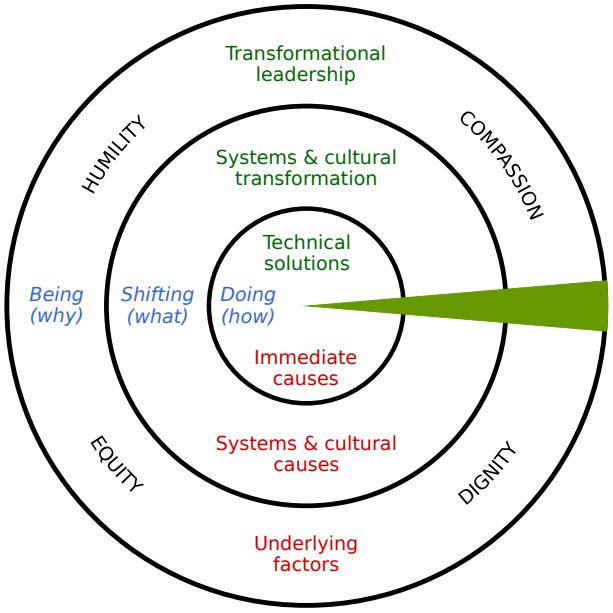


Figure 9. The Conscious Full-Spectrum Response (CFSR)

(a) Being change: the contemporary pioneer

"I am the contemporary pioneer grounded in universal values manifesting my greatness through compassionate and courageous action. … How can I be courageous, listen deeply, be willing to alter my perspectives based on universal values, and be strategic at the same time? …" [5].

Innate human attributes and universal values

All human beings have three innate attributes: (a) our universal heart of *compassion*, (b) an empathetic burning for *fairness* (equity), and (c) our discerning eye for *seeing patterns*. "Discernment is our ability to hold multiple perspectives without compromising the universal values we stand for. We are able to transcend our usual reactivity and impulsiveness and interpret what is going on without prejudice or bias. We make decisions without being judgmental, anchored in universal values, willing to alter our point of view in the interest of humanity as a whole" [5].

To strengthen our innateness, we commit to embodying the **core universal values** of humility, compassion, equity (fairness), and dignity. In public health [25], we also embody other universal values: social justice, interdependence, respect, community self-determination, integrity, empathy, transparency, and courage. Public health leaders also embody these *traits*: comfort with ambiguity, passion, persistence, and initiative; and these *principles*: requisite role of government and reliance on evidence [25].

Knowing who I am for strategic action

"Knowing who I am and sourcing my inner power for transformation are foundational steps to unleash my human potential" [5]. I must work on (a) discovering who I am and what I stand for—knowing my *innate greatness*; (b) articulating what I stand for and *saying it*; (c) knowing my fears; (d) transcending my fears (this is *courage*); (e) commitment through action (*purpose* → *contribution*); and (f) creating platforms for others to source inner capacities for action and results (coaching others in leadership).

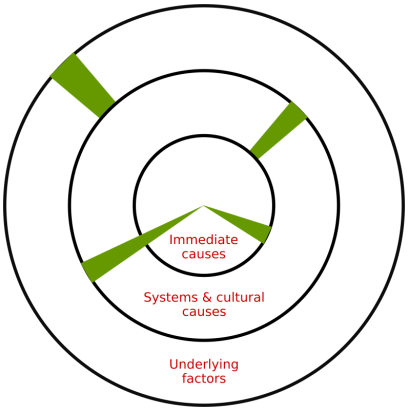


Figure 10. Partial-spectrum responses are incomplete, nonaligned

Embracing "identities" as assets

We must identify, embrace, and manage our multiple identities (profiles) to maximize good and minimize harm: (a) inner capacity or wisdom profile; (b) social profile (sex, gender, sexual orientation, family and community roles, political affiliations); (c) professional profile (expertise, work roles); and (d) personality profile (see "Personality and habits" on p. 19).

For us, *wisdom* is "our inner capacity for compassionate, courageous action in the world. … This is a space of renewal that leaves people inspired, empowered right now. It is mindful action in the now—not a someday or a one day phenomenon. We are impacted and we impact the world *right now*" [5].

Bridging the nondual and dual worlds

"The nondual universe is where you and I are one" (wholeness, completeness, unity). "The dual world is the outer world we live in, where there are differences, and our experiences are named, defined, and measurable. … Phenomena in the dual world are interdependent and related through cause and effect."

"How do we engage at the cusp of the nondual universe and dual world and connect who we are with what we do? Our entire work is designed to bridge the nondual universe and the dual world." Here are practical tools to integrate these divergent worlds: (a) **Conscious Full-Spectrum Response**; (b) **compassion**—universal heart responses leading to action; (c) **listening** with our still mind and wide-open compassionate heart; and (d) **worldviews** emanating from "Who I am BEING and what I stand for."

Bridge—Conscious Full-Spectrum Response: "To unleash our full potential we need to picture the whole, then bridge the nondual 'picture-less' universe and the dual world of cultural norms, systems, and action. In this whole picture, three spaces can be activated simultaneously through inquiry, insight, and specific results orientation. Figure 9 illustrates the CFSR, which is used to bridge the dual and nondual worlds in project design."

"*The first space is the nondual universe*, where we are one, and we stand in our unique universal values and commitment to

action. *At the cusp of the nondual universe and the dual world* stakeholders articulate the core values for the project. *The second space is the dual world of invisible, multiple patterns and systems, cultural norms, and 'rules of the game'* that require us to create alternative strategies for equitable and sustainable results. *The third space is the dual world of solutions and action*, including technical know-how to solve problems."

Bridge—Compassion: "A compassionate open heart is a space of endless possibilities—a nondual space of higher consciousness where spacious awareness is in unison with mind, emotions, and body. … When we distinguish these two spaces with awareness and *act* from our courageous compassionate heart, we bridge the nondual and dual spaces by BEING through action."

Bridge—Listening: "As human BEINGS, we can learn to still our minds and open our hearts to listen deeply to people, simultaneously aware that we constantly mentally filter what people say and do. When we are aware of our mental filters, we are able to notice when they surface; and this is the beginning of releasing our biases. … This way of listening has a different purpose. It is to listen in a way that sources our oneness in the nondual universe in order to act in the dual world. When I learn to still my mind, I am able to listen with my heart wide open without judging the person or jumping to conclusions." (Also see "Reflective Listening" on p. 9.)

Bridges—Worldviews: "Having a worldview based on who I am being and what I stand for is different from perspectives based on logic and ideology. I am using *worldviews* to mean views based on universal values and *perspectives* to mean views emanating from ideological stances."

"The complex world today requires us to be aware of how our perspectives, ideologies, and worldviews have been formed—from our education and culture," etc. … "We don't need to necessarily negate our perspectives. But we do need to inquire into the assumptions behind these perspectives so as to embrace them differently, based on who we are, what we stand for, and universal values."

"Our understanding determines the decisions we make." We strive for "a way of discovering the most beautiful, most powerful, most compassionate space of our being: our oneness. Out of this discovery, we know that we can listen to each other differently and deeply; we can listen to each other and be willing to change our point of view without compromising on any of the universal values."

BEING a paradigm shifter

"There is a foundational difference between focusing solely on achieving a goal and engaging in order to accomplish a principled game-changing paradigm shift." This means (a) embodying values instead of talking about values, and (b) stillness.

Embodying values instead of talking about values: "BEING a paradigm shifter requires us to embody values instead of only talking about values. It requires us to avoid fundamentalism or any other isms or dogmatic perspectives. Our courage to create is grounded firmly in our universal values, our oneness—the inner capacity, wisdom, full potential—and our stillness in urgent action."

Cynda Rushton, bioethics professor at Johns Hopkins University, says "One of the most profound aspects of the CFSR is the grounding in who am I being in this moment. This orientation has engaged a deep space of personal inquiry with mindfulness as the foundation for engaging wisdom and compassionate action. Instead of beginning with what I will do, the CFSR approach invites inquiry into who I am. What do I stand for? … Clarity in who I am and what I stand for has provided me with an anchor through many leadership challenges" [5].

Stillness: "We are often given advice to 'slow down' instead of 'learn to be still'." We must practice stillness "to allow our wisdom, our inner capacity to surface—to create the space between our thoughts." (See "Quieting Ego" and mindfulness on p. 8.)

(b) Designing change: the unifying architect

Our design capability

The pubic health leaders designing change are *unifying architects*. "The unifying architect is fearless, has reverence for life in all it manifestations, and sees the beauty of uniqueness and diversity in our inherent oneness, in the interdependence of humans, all sentient beings, and our earth" [5] The unifying architect (a) has the compassionate courage to act; (b) is a principled game changer, sourcing inner capacities and creativity; (c) sees and takes into account the invisible patterns, norms, and systems as well as root factors that shape global and local situations and actions; (d) crafts policies, projects, and processes for enduring equitable and sustainable change; (e) is proficient in using transformative design templates; and (f) generates transformational results, steadily contributing to paradigm shifts [5].

Praxis of a unifying architect: How do we do this? (a) explore ways to continuously deepen personal transformation; (b) embrace confusion as a creative space for emergence; (c) see connections and patterns with discernment and pristine clarity; and (d) speak fearlessly about underlying factors of major challenges. For example, poverty is not a root cause. Poverty is a result that that emanates "from human beings who have not touched their inner compassionate core;" whose individual and collective decisions are the expression of cultural norms and systems where the universal values of dignity, equity, compassion, and humility are the exception rather the rule. As Nelson Mandela said, "Poverty is not an accident. Like slavery and apartheid, it is man-made and can be removed by the actions of human beings" [5].

Design template 1: Conscious Full-Spectrum Responses

The Conscious Full-Spectrum Response (Figure 9 on the preceding page) is a holistic, results-based template to organize and monitor your being, designing, and lead change. Table 3 on the next page summarizes how the CFSR complements or strengthens other leadership models. For example, the CFSR accommodates Roger Gill's six themes of leadership (see p. 13) and Simon Sinek's "Golden Circle"—a popular leadership model.[7]

[7] https://startwithwhy.com/

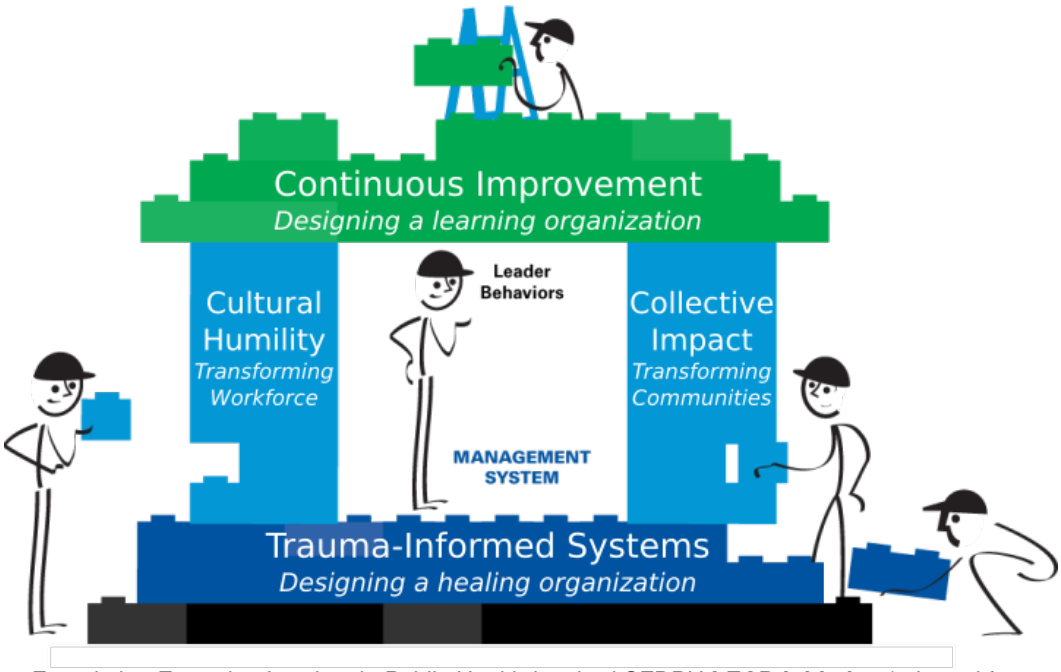


Figure 11. Kresge Foundation Emerging Leaders in Public Health-inspired SFDPH **LEAD Initiative** (adapted from http://www.lean.org/WhatsLean/TransformationFramework.cfm)

Table 3. CFSR design is a values-based results framework

Circle	Leadership themes (adapted from Gill [46])
Why	*values* (universal), *purpose* (or mission), *vision*
What	*strategy*: design shift in systems and cultural norms
How	*engagement*, *empowerment*, and population health lean (collective impact, design thinking, RBA, etc.)

Design template 2: Synergistic operational strategies

"The architecture for generating a paradigm shift with equitable and sustainable results needs to be operationalized and put into practice. Synergistic operational strategies (SOS), when put in place, generate exponentially greater impact. They operate in tandem with the different components of the conscious full-spectrum response framework, expanding our ability to respond to complex challenges" [5].

"Synergy occurs when the interaction or cooperative efforts of two or more entities, organizations groups, or other agents produce a combined effect greater than the sum of their separate effects. When we design for synergy, we achieve more with less." [5]. In population health lean we use collective impact (see p. 30).

The purpose of SOS is to design and deploy activities to transform the organizational or project culture to support sustainable and equitable processes, results, and impacts. SOS has two stages:

Stage 1

1. Developing transformational leadership and stewardship
2. Producing actionable knowledge (see pp. 18, 42, and 46)
3. Creating an enabling, supportive, and safe environment
4. Supporting principled change-makers and risk-takers

Stage 2

1. Developing people (teams, organization, community)
2. Improving data measurement and developing new metrics
3. Generating new narratives to shift systems and cultures
4. Scaling for interdependent, sustainable transformation

Design template 3: Transformational results chain

For transformational results chain read about collective impact using Results-Based Accountability™ (see p. 30).

BEING a principled game changer

"A principled game changer requires *criteria* for the ideas and initiatives to be game-changing. . . . we must have explicit, simple criteria to know whether our intentions are actually changing the rules and norms of the game." Think "UR-GOAL".

U Universal values: dignity, equity, compassion, and humility.
R Results-thinking[8] with process improvements.
G Give more power to people.
O Open our eyes to the beauty of community and purpose.
A Accounts for all costs (minimize unintended consequences).
L Lessens the wealth and equity gaps.

Kresge-inspired LEAD initiative

Public health leaders promote organization and community transformation. The SFDPH has committed to four areas of continuous radical transformation (see Figure 11). This document is a product of the Kresge-inspired LEAD initiative.

1. Designing a healing organization (see p. 17)
2. Designing a learning organization (this document)
3. Transforming workforce (e.g., cultural humility)
4. Transforming community (e.g., collective impact)

[8] How much did we do? How well did we do it? Is anyone better off?

8. Designing healing organizations

Population health lean will lead to a *learning organization*. However, many of us serve communities, families, clients, and patients that have been, and continue to be, traumatized by socioeconomic conditions, discrimination, marginalization, racism, and other "isms." Our diverse staff often come from these communities. Organizational transformation must include understanding trauma, healing, and resilience. Therefore, we need to design *healing organizations* (see http://traumatransformed.org/).

Here are the six core principles of healing, **trauma-informed systems** that form the basis of our training at SFDPH: (a) understanding trauma and stress, (b) compassion and dependability, (c) safety and stability, (d) collaboration and empowerment, (e) cultural humility and responsiveness, and (f) resilience and recovery.

1. Understanding Trauma and Stress

Without understanding trauma, we are more likely to adopt behaviors and beliefs that are negative and unhealthy. However, when we understand trauma and stress we can act compassionately and take well-informed steps toward wellness.

2. Compassion and Dependability

Trauma is overwhelming and can leave us feeling isolated or betrayed, which may make it difficult to trust others and receive support. However, when we experience compassionate and dependable relationships, we reestablish trusting connections with others that foster mutual wellness.

3. Safety and Stability

Trauma unpredictably violates our physical, social, and emotional safety resulting in a sense of threat and need to manage risks. Increasing stability in our daily lives and having these core safety needs met can minimize our stress reactions and allow us to focus our resources on wellness.

4. Collaboration and Empowerment

Trauma involves a loss of power and control that makes us feel helpless. However, when we are prepared for and given real opportunities to make choices for ourselves and our care, we feel empowered and can promote our own wellness.

5. Cultural Humility and Responsiveness

We come from diverse social and cultural groups that may experience and react to trauma differently. When we are open to understanding these differences and respond to them sensitively we make each other feel understood and wellness is enhanced.

Humility is a profound topic worthy of in depth study. Review NewSmart Humility (p. 8) and cultural humility (p. 10).

6. Resilience and Recovery

Trauma can have a long-lasting and broad impact on our lives that may create a feeling of hopelessness. Yet, when we focus on our strengths and clear steps we can take toward wellness we are more likely to be resilient and recover.

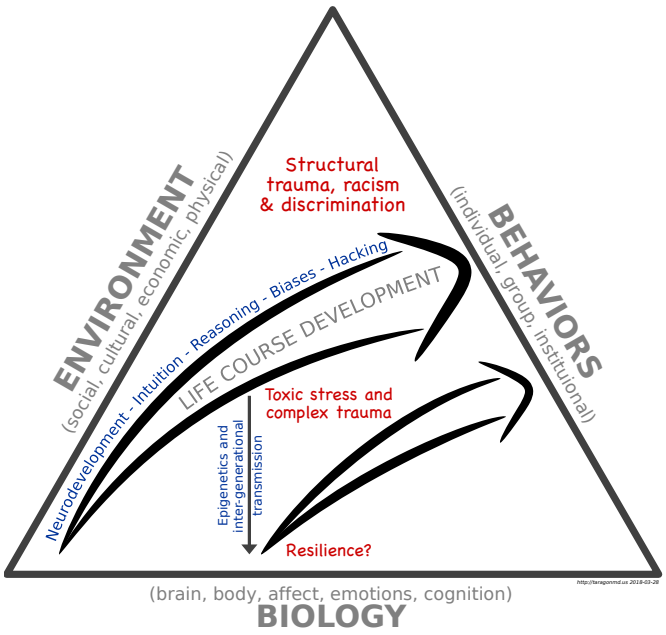


Figure 12. Radical health development model (adapted from a UCSF-UC Berkeley RWFJ population health model)

Structural trauma and the radical health development model

Healing health organizations partner with communities to become trauma-informed, healing communities. This requires addressing **structural trauma** (poverty, racism, discrimination, exploitation) and its effects on the most vulnerable in society—children from preconception to age five.

Therefore, we must be focus on

1. **structural trauma, institutional trauma, and toxic stress** (e.g., adverse childhood experiences) [47],
2. **inter-generational transmission of trauma effects** (biological and social risk) to offspring,
3. **life course precognitive development** affecting a child's brain, learning, behavior, and health for life [48], and
4. **industry exploitation of our neuro-vulnerabilities** to design and market products for addiction and overconsumption (tobacco, alcohol, prescription opioids, processed foods, gambling, gaming, etc.) [49].

The **radical health development model** (Figure 12) provides a practical lens to prioritize social and economic policies that improve social determinants of health, especially those that protect and promote (a) the healthy neurocognitive development of our most vulnerable (unborn and young children), and (b) the social and economic protection for young families.

The radical health development model enables us to "connect the dots" and tell the coherent story of how structural, institutional, and intentional trauma (poverty, racism, discrimination, brain-hacking, etc.) connect to (a) neurodevelopment, including executive function [47]; (b) cognitive biases, including systems 1 and 2 [34,50]; (c) decision making [17]; (d) brain-hacking (design of addictive products) [49]; (e) trauma-informed systems; (f) cultural humility [39] (g) racism, including implicit biases [51]; and (h) multi-generational, life-course racial health inequities [52].

9. Understanding intuitive decision-making

> *Our comforting conviction that the world makes sense rests on a secure foundation: our almost unlimited ability to ignore our ignorance.*
>
> *. . . Daniel Kahneman [34]*

Section 15, "Improving strategic decision-making," covers *how we should make decisions*—through a deliberative process using quality criteria. Team deliberation improves with cognitive diversity and constructive conflict (see p. 11). However, we must first understand *how we naturally make decisions*. It turns out that the vast majority of our daily decisions are made using intuition (our "gut"). As we will learn, intuitive decision-making is fraught with traps and can lead to poor decisions with high-stake consequences—even death![9]

Understanding how cognitive biases affect decisions as individuals and as teams is essential to improving intuitive and deliberative decision-making.

Cognitive biases in decision making

In 2002, psychologist Daniel Kahneman won the Nobel Prize in Economics, and in 2011 published *Thinking, Fast and Slow* [34] that summarizes his research in cognitive biases and heuristics that effect our judgment, choices, and behaviors. His contributions helped to grow the exciting field of behavioral economics.[10]

System 1 and System 2 (a.k.a. the elephant and the rider)

Cognitive biases affect our perceptions, judgments, emotions, decisions, and actions. These biases are sometimes called "effects," "traps," or "pitfalls." Our brain uses two mental processes called System 1 and System 2. **System 1** is the fast, automatic, emotional ("hot"), nonconscious process that drives intuitive ("gut") decisions, and **System 2** is the slow, reflective, rational, conscious process that enables deliberative decisions. From an evolution lens, System 1 is primitive and based on the principle of "What You Sense Is All There Is" (WYSIATI). It has the enormous capacity to process data via our senses and automatically respond with a classification and/or an emotion (a physiological response) that is handed off to System 2 for action or further processing (i.e., reflection, deliberation, impulse control, decision-making).

System 1 uses mental models (schemas) that have accumulated over time (e.g., racial stereotypes) and is prone to errors, especially when the data is novel or ambiguous. System 1 is home to our innate processes (human drives, personality traits, emotions, fight-flee-freeze response[11]), and acquired mental and motor habits, implicit biases, and addictions.

In their bestselling book *Switch: How to change when change is hard*, Chip and Dan Heath popularized System 1 and System 2 using the metaphor of an elephant and a rider (Figure 13) [53].

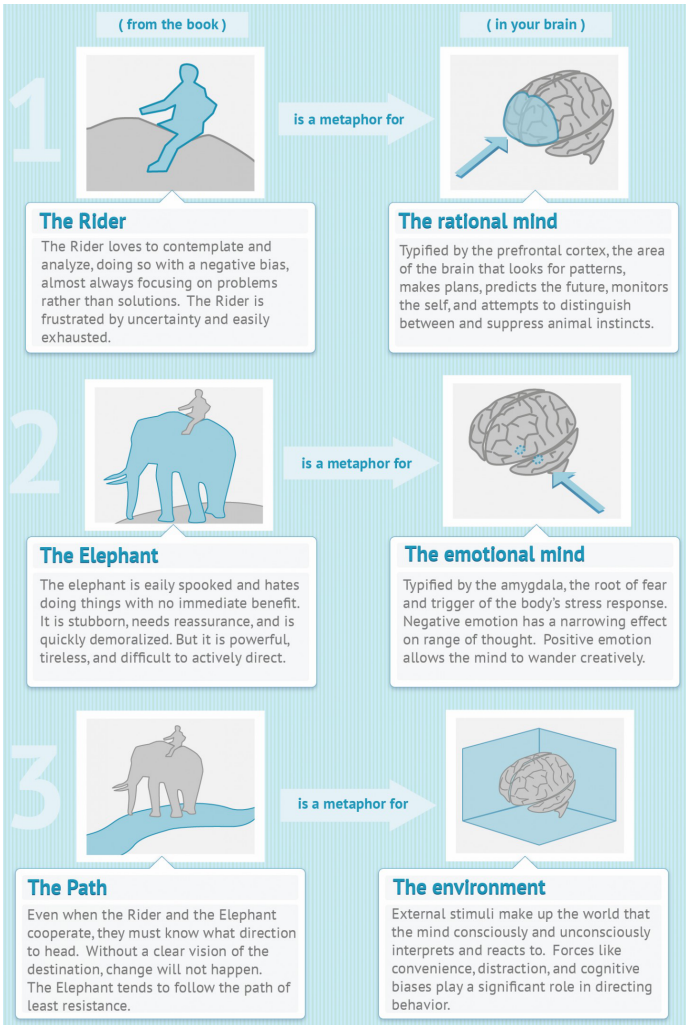


Figure 13. The rider (System 2) attempts to understand, control, train, and direct the elephant (System 1) (medium.com/@ptvan).

System 2 is the "rider" and System 1 is the "elephant"—it never forgets! If the rider had optimal childhood, adolescent, and young adult neurodevelopment, it would exhibit good **executive function**: (a) attention control, (b) emotional regulation, (c) impulse override, and (d) behavioral modification. Executive function uses working memory, reflection, learning, problem-solving, planning, and strategic decision-making. Fortunately, when executive function is intact and mature, the rider can control and train the elephant, albeit with a lot of effort. An exhausted System 2 (rider) is susceptible to System 1 (elephant) impulses.

For example, we all know of national leaders whose gender and racial biases, inability to focus attention, regulate emotions, override impulses (poor decisions and actions), and modify behaviors in spite of adverse consequences to self, family, and nation, can all be understood and explained by poor executive function.

We must understand System 1 and System 2 (Table 4 on the next page) in order to design, deploy, and improve our intuitive and deliberative decision-making, trauma-informed systems, NewSmart and Cultural Humility, change management strategies, trust building, conflict management, and lean management.

[9] See Michael A. Roberto (2002). High stakes decision making: The lessons of Mount Everest. HBS Working Knowledge: Business Research for Business Leaders. Available from http://hbswk.hbs.edu/item/3074.html

[10] The study of the effects of psychological, social, cognitive, and emotional factors on the economic decisions and behaviors.

[11] Also called the "fight-or-flight" response

Table 4. Comparison of System 1 versus System 2

System 1 ("elephant")	System 2 ("rider")
Nonconscious	Conscious
Fast, parallel processing	Slow, serial processing
Automatic	Controlled
Associative	Rules-based (reasoning)
Intuitive ("gut")	Reflective (deliberative)
Energy efficient	Energy hog (exhausting)
Implicit knowledge	Explicit knowledge
Not linked to language	Linked to language
Uses stored memory (schemas)	Uses working memory
Emotional ("fight-flee-freeze")	Rational

From NewSmart Humility we learned about natural human *defensiveness* from the drive to *protect our ego* (self-concept) and *avoid our fears* (vulnerability, uncertainty, risk, intellectual or emotional exposure, uninvited scrutiny). Fear ("fight-flee-freeze" response) is generated by System 1. Now we cover cognitive biases and traps that involve the interaction of System 1 and System 2. Spetzler, et. al have clustered the most important of these into six categories relevant to decision-making (Figure 14). To date, more than 200 cognitive biases have been identified [54].

1. Protection of mindset

Mindsets are "all the stuff in our heads: beliefs, mental models of reality, lessons learned, memories, preferences, prejudices, and unconscious assumptions. We use these to make sense of the world and to make judgments and decisions. Whenever we encounter something that conflicts with our mindset, the first impulse is to reject or attack it, as an antibody would attack an alien organism" [17].

System 1 and System 2 team up to protect our mindsets using the following cognitive biases: (a) avoiding dissonance, (b) confirmation bias, (c) overconfidence, (d) hindsight bias, (e) self-serving bias, (f) status quo bias, and (g) sunk cost bias.

Whenever we sense data that conflicts with a mindset, we experience a discomfort psychologists call *cognitive dissonance*. Our mind cannot sustain dissonance; therefore, we mitigate it by ignoring, discrediting, or explaining away the data. Accepting the data would require changing our mindset which is difficult because we seek out data that confirms our mindset (*confirmation bias*) and we avoid data that challenges it (*avoiding dissonance*).

Humans overestimate their capabilities (*overconfidence*). We are all "Monday morning quarterbacks" (*hindsight bias*). We give more weight to our positive qualities than our negative qualities (*self-serving bias*). We attribute "successes to our efforts while writing off failures to bad luck or situational factors" [17].

With the *status quo bias* "we stubbornly cling to the current position, technology, or ... strategy and for too long—and even escalate our commitment to it despite evidence that it's not working, in the hopes that things will improve" [17]. In a variant, the *sunk cost bias*, we decide to continue the current course because we have already invested large resources (money, staff, and time) and not because it is the best choice using objective criteria.

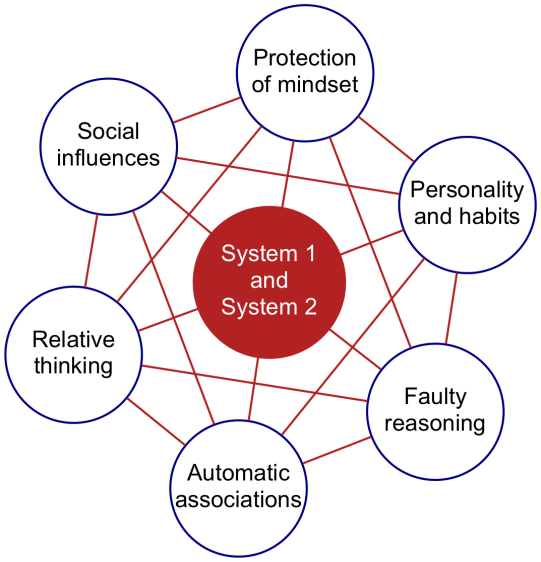


Figure 14. Classification of cognitive biases affecting perceptions, judgments, emotions, decisions, and behaviors

2. Personality and habits

"Another critical source of decision bias is our collection of habits and the personality characteristics that create them" [17]. A *habit* is a mental and/or motor process that becomes automatic (System 1) and its origin can be from System 1 (nonconscious) or System 2 (through intentional practice). When we are aware of a habit, we can control or change it (System 2) but only with significant effort. Mental habits can influence our decision making.

Personality refers to individual differences in characteristic patterns of thinking, feeling and behaving.[12] Several frameworks exists to explain personality [55]. To understand intuitive decisions we use the popular Myers-Briggs Type Indicator (MBTI) personality inventory based on Carl G. Jung's theory of psychological types. The MBTI has four binary dimensions:

1. *Favorite world:* Do you prefer to focus on the outer world or on your own inner world? This is called **Extraversion** (E) or **Introversion** (I).
2. *Information:* Do you prefer to focus on the basic information you take in or do you prefer to interpret and add meaning? This is called **Sensing** (S) or **Intuition** (N).
3. *Decisions:* When making decisions, do you prefer to first look at logic and consistency or first look at the people and special circumstances? This is called **Thinking** (T) or **Feeling** (F).
4. *Structure:* In dealing with the outside world, do you prefer to get things decided ("convergent" thinking) or do you prefer to stay open to new information and options ("divergent" thinking)? This is called **Judging** (J) or **Perceiving** (P).

Figure 15 on the following page graphically depicts the four dimensions. For detailed descriptions of each see footnote URL.[13]

Extroverts are energized by engaging the outside world ("thinking out loud"), Introverts are energized by engaging their thoughts. Sensing-types prefer information that is concrete and self-evident.

[12] Source: http://www.apa.org/topics/personality/

[13] See http://www.myersbriggs.org/my-mbti-personality-type/mbti-basics/

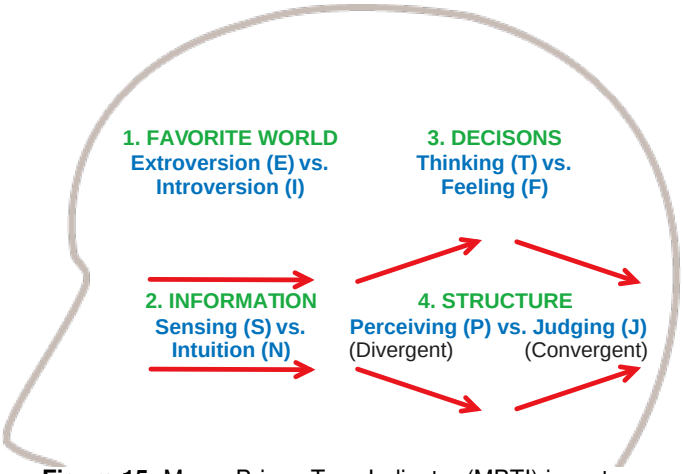


Figure 15. Myers-Briggs Type Indicator (MBTI) inventory

Intuition-types prefer information that is nuanced, conceptual, and high-level. Thinking-types like to make decisions using logical reasoning. Feeling-types like to make decisions focused on people's feelings. Perceiving-types delay decision-making to keep options open and to collect more information. Judging-types accelerate decision-making focused on action over deliberation.

MBTI captures strong cognitive preferences that drive decisions, behaviors, and habit-formation. Personality type is like being right-handed: we can write with our left hand, but we strongly prefer to write with our right hand. From a self-administered survey, a person will be assigned four letters; for example, ENTJ. Your MBTI changes little over your adult life. Differences in personality-types can lead to poor communication, misunderstanding, and conflict.

Understanding personality-type is critical for (a) understanding that extroverts tend to speak out and get heard, while introverts may need more time to gather ideas; (b) designing communication strategies, taking into account people's preferences for receiving information; (c) understanding our preferences for intuitive decision-making; e.g., decisions made by Thinking-types may come across as cold and heartless (think Mr. Spock!); and (d) designing decision processes that diverge (consider many creative options) and that converge (make a decision), and not get stuck in one personal preference style (i.e., perceiving vs. judging).

Personality type can lead to the following cognitive biases: (a) preference-based habits, (b) habitual frames (c) content selectivity bias, and (d) decision styles. Similar to learning how to do things with your dominant hand, your personality will shape your thinking and doing habits (*preference-based habits*)—and it's very hard to change! Sensing-types prefer narrow decision frames, and Intuition-types prefer expansive decision frames (*habitual frames*). Feeling-types are biased toward information about peoples emotions; Thinking-types are biased toward information that is objective and measurable. In decision-making, Extroverts want to openly deliberate and introverts prefer to think and write (*decision style*). Well designed decision processes engage diverse personality types, ensuring balance and closure (i.e., divergence followed by convergence).

3. Faulty reasoning

System 1 processes raw data using our senses. In contrast, reasoning is a System 2, logical, deliberative process that analyzes data, and manages, synthesizes, and translates knowledge to draw inferences (conclusions), and to inform or influence decision making. The major cognitive threats to sound reasoning are complexity and uncertainty.

Faulty reasoning due to complexity: Complexity (complex systems) involves entities (people or processes) that are diverse, connected, interdependent, and adapting. Complex systems, especially involving people, are dynamic, ambiguous, and unpredictable. In spite of our best intentions we are susceptible to these cognitive biases: (a) selective attention, (b) inability to combine many cues reliably, (c) substitution heuristic, and (d) order effects.

"The human mind is confused by multi-dimensional problems and loads of data. In response, we often oversimplify. We apply *selective attention* to the variables that seem most important while ignoring the rest. In situations where many value dimensions are important, we still end up focusing on just a few key attributes because of our *inability to combine many cues reliably*. We use a *substitution heuristic* to shift attention from a tough question ("How much effort should we spend on this decision?") to an easier one ("How much time do we have before the next executive committee meeting?"), even though the answer to the easier question may have very little to do with the question that we really need to answer. When face with many different pieces of information, another trap, based on *order effects*, leads us to remember those ideas that are either first or last. In general, when things get complicated, we oversimplify, whether we realize it or not" [17].

Faulty reasoning about uncertainty: "Uncertainty—always an element in big, difficult decisions—confounds the mind's reasoning capacity. Even highly trained professionals make mistakes when they have to reason through uncertain situations" [17]. In public health and medicine we use probability theory and Bayes theorem to mitigate *confusion about uncertainty*. Unfortunately, even for the simplest scenarios, no human brain's System 2 is capable of calculating posterior probabilities given prior probabilities and performance characteristics (e.g., sensitivity and specificity of diagnostic tests). At a population level intuition was "good enough" for evolutionary competition between species; however, today we must reach for System 3—methods, tools, and experts—to navigate uncertainty. First and foremost, this requires humility—NewSmart Humility (p. 8). We cannot overcome our limitations if we do not acknowledge them and commit to improving.

To tackle complexity and uncertainty today we turn to design thinking and data science to analyze, synthesize, simulate, and optimize inputs, outputs, and outcomes; to gain insights that exercise our intuition; and to deliver customer value. No individual has all the expertise and experience for this challenge. Culturally diverse, transdisciplinary teams is the only way to go!

4. Automatic associations

Our nonconscious mind automatically judges data to be more important or probable if they are recent, vivid, readily available,

or coherent. The converse is true: data that are not recent, vivid, readily available, or coherent are judged to be less important or probable. This leads to a group of related cognitive biases: (a) *ease of recall*, (b) *availability effects*, (c) *vividness bias*, and (d) *narrative fallacy*. In the narrative fallacy, a believable good story is judged to be more important or probable, even if it is not.

In the *halo effect* an entity is judged to be important if it is associated with someone or something that is already considered to be important. For example, politicians like to be photographed with popular movie stars or sports figures because of their halo effects.

When we estimate uncertain quantities, our estimate can be influenced, nonconsciously, by exposure to recent, unrelated numerical data (*anchoring effects*). The greater the uncertainty of the estimate, the greater the anchoring effect bias. Because these automatic associations happened nonconsciously we are completely unaware of these influences.

5. Relative thinking

How we frame an issue effects how our brain perceives it (*framing effects*). For example, if a doctor informs their patient that a proposed surgery has a 95% chance of survival, the patient will perceive the risk very differently than if the doctor had informed the patient that the proposed surgery has a 5% chance of death. Framing effects are common; however, we cannot predict the magnitude or direction of the effects, so we must run experiments and learn.

Studies show that people will travel an extra 15 minutes to pay $10 for an item rather than pay $15, saving 30%. However, they are unwilling to travel an extra 15 minutes to pay $100 for an item rather than $105, saving 4.8%. Why? In both cases one can save $5, there should be no difference. But there is, and it's called the *reference point effect*. Consider how spending an extra $5000 feels when buying $25,000 car versus spending an extra $5000 when buying a $1 million home.

Going outside when in freezing temperature and snow feels very different if the context is your winter vacation and you love skiing, or if the context is commuting to work (*context effects*).

6. Social influences

Humans are social creatures and we want to be liked, valued, and respected. We change our behaviors to "fit in" (*conformity*). When we need answers to a problem we are susceptible to accepting suggestions without too much scrutiny (*suggestibility*), especially if it's from a source we "trust." Like rumors, suggestions can quickly spread through a group (*cascades*). At work, teams are averse to conflict so they "go along to get along"—also known as *groupthink*.

Mitigating cognitive biases

To commit the biases to memory ("mindware") remember **SP**^{2}**AR**^{2}: **S**ocial influence, **P**rotection of mindset, **P**ersonality and habits, **A**utomatic associations, faulty **R**easoning, and **R**elative effects. Embrace NewSmart Humility! Be humble! Be mindful! Be reflective! Experiment! Learn! Use System 3 tools and experts.

Megabiases that undermine decision quality (DQ)

We encounter megabiases when "multiple individual biases work together to cause dysfunctional decision making. These megabiases can be even greater threats to good organizational decision making that the individual biases . . . " [17]. Quality decisions fulfill six criteria: appropriate frame, creative choices, relevant and reliable data, clear values and trade-offs, sound reasoning, and commitment to action.

Megabias 1: Narrow framing

The most common and important group decision trap is plunging in without designing an appropriate frame (purpose, perspective, and scope; see p. 43). The frame is usually narrow, or sometimes even wrong. Our bias to action gives an illusion of decisiveness. Without a DQ framework and appropriate frame to guide us, we are susceptible to making poor decisions on the wrong problem.

Megabias 2: Illusion of decision quality

"Many believe that they were selected for leadership roles *because* of their natural decision-making capabilities. In fact, they, like the rest of us, are wired to make *good enough* decisions rather than quality one. Then, we make ourselves feel good about our choices by finding confirming evidence, applying hindsight, and using other self-serving biases, creating the illusion of DQ" [17].

Megabias 3: Agreement trap

Under the right circumstances, groups make better decision than individuals. However, "the dynamics of group behavior can lead to conformity, groupthink, and exaggeration of the DQ illusion. This creates another megabias called the *agreement trap*, where we confuse agreement with a good decision. Agreement encourages people to say, 'This must be a good choice—we all agree.' However, agreement has little to do with the requirements for DQ" [17].

Megabias 4: Comfort zone megabias

Teams, like individuals, develop preference-based habits. When combined with self-serving, decision style, and confirmation biases, "the result is the *comfort zone* megabias: the tendency to drag a problem that we know how to solve, rather than solving the problem into our comfort zone and solve the problem that we know how to solve, rather than solving the problem that actually needs to be solved. . . . The comfort zone megabias combines many individual biases and is widely observed. This creates one of the most important challenges facing decision makers: We do what we know how to do, rather than what the decision requires" [17].

Megabias 5: Advocacy/approval myth

Many organizations assign a team to solve an important problem and recommend their best decision. The team then presents their best decision to an executive approval body and advocates for acceptance. The *advocacy myth* is when "effective advocacy is misinterpreted as evidence of the quality of the recommended decision" [17]. The corollary is "the *approval myth*, the idea that any proposed solution that is approved after intense interrogation by the approval body must be of high quality" [17]. To have DQ, the decision and approval processes must focus on DQ criteria.

10. Population health lean thinking

Building upon NewSmart Humility, lean thinking is a core practice of population health lean, and consists of three components:

1. PDSA problem-solving
2. Validated learning
3. A3 reporting

PDSA (scientific) problem-solving

PDSA stands for Plan-Do-Study-Act. PDSA is the scientific method and we have been using it all of our lives. PDSA thinking and problem solving is part of human nature: it is how we try things, learn, and adapt. Unfortunately, many believe, mistakenly, that the scientific method is only for scientists. By recognizing that we are already scientific thinkers we can improve our daily decision-making, problem-solving, innovation, and performance.

PDSA is both simple and profound. In practice, PDSA is a learning *and* improvement cycle based on experiments. This differs from Plan-Do-Check-Act (PDCA) which is primarily an improvement cycle. PDSA has two distinct, but related, purposes:

- knowledge deployment: experiments to test a new practice
- knowledge discovery: experiments to test a new theory

A *theory* is an explanatory (cause-effect) model which may be explicit, invisible (e.g., cultural norm), or unconscious (e.g., implicit racial bias). In *knowledge deployment* we experiment to test a new practice idea without challenging or testing the underlying theory. We hypothesize the new practice is better than the old. Our intent is to improve practice. In *knowledge discovery* we experiment to test a new theory. We hypothesize the new theory is valid (or invalid). Our intent is to improve theory. Linking knowledge discovery to deployment encourages research that is more likely to lead to breakthroughs in practice and impact.

Table 5 displays PDSA for daily problem-solving. PDSA activities are listed: (a) define the problem (or opportunity) and set objectives; (b) design a process to discover root causes and possible solution options, and to develop criteria for selecting options; (c) decide on options for testing (experiments); (d) predict the results (outputs, outcomes); (e) conduct the experiment; (f) learn by mindful observation (total focus, free of judgment and expectation); by reasoning using sound logic; and by reflection (looking for deeper meaning); and (g) improve by adopting, adapting, or abandoning the option for the next iteration. Also included in Table 5 are PDSA variants from two enormously effective and complementary approaches called design thinking (human-centered design) [16] and lean startup [15, 56, 57].

The secret to PDSA is prediction [58]: "People learn better when they predict. Making a prediction forces us to think ahead about the outcomes. Making a prediction also causes us to examine more deeply the system, question or theory we have in mind" [59]. "We will learn much more if we write down our prediction. Otherwise we often just think (after the fact), 'yeah that is pretty much what I expected' (even if it wasn't)" [60]. We *learn* by experimenting to narrow the knowledge gap between prediction and results. We *improve* by using what we learn to narrow the performance gap between current and desired results.

Table 5. PDSA for daily problem-solving[a] (and variants)

PDSA	Core activity	Design thinking (see p. 41)	Lean startup (see p. 40)
Plan	Define-Decide Design-Decide **P**redict	Empathize Define Ideate	↓ ↓ (Ideas)
Do	**E**xperiment ↓	Prototype Test	Build (product) Measure (data)
Study	**L**earn[b]	(learn)	Learn
Act	**I**mprove[c]	(improve)	(improve)

[a] Every day think: **P**redict – **E**xperiment – **L**earn – **I**mprove (PELI)

[b] Mindful observation, Reasoning, and Reflection

[c] Adopt, adapt, or abandon ("pivot or persevere")

PDSA single and double-loop learning

Incremental performance improvement occurs by improving practices, and practices are based on accepted theories. A theory is an explanatory (cause-effect) model that can explain observed phenomena. Theories are not always explicit; they can be assumptions or mental models, sometimes they are hidden. The typical approach is to use PDSA cycles to test and adjust practice improvements. We plan to test a practice innovation, we test (do) the practice innovation, we study the results, and we act on what we learned, leading to incremental improvements.

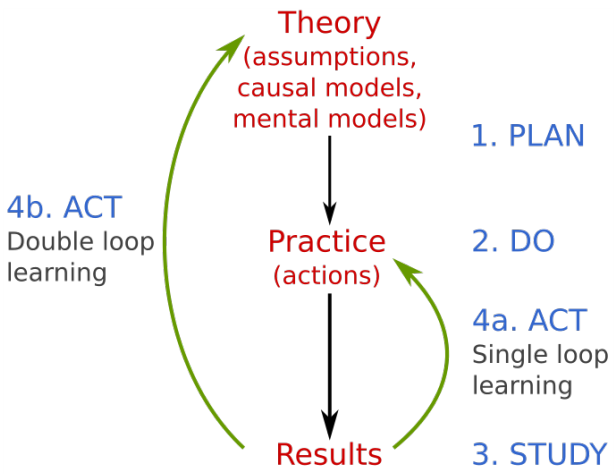


Figure 16. PDSA single and double-loop learning. Mental models include cognitive traps and biases, including implicit biases.

Chris Argyris called this *single-loop learning* [27]. He recognized that PDSA can also be used for *double-loop learning* which can lead to new theories and breakthrough performance improvements. Figure 16 depicts PDSA with single-loop and double-loop learning. For example, when efforts to improve a practice are failing (unsatisfactory results), we have two choices:

1. continue attempts to improve the practice (single-loop learning; possible incremental improvements), or
2. consider improving the theory (double-loop learning; possible breakthrough improvements)

Double-loop learning makes these possibilities explicit and encourages innovative (breakthrough) thinking.

Double-loop learning is groundbreaking for practitioners pursuing performance improvements. Double-loop learning (a) provides an alternative learning path when attempts to improve current practices are failing; (b) raises awareness of hidden cause-effect assumptions that may be driving poor results but not explicitly acknowledged (e.g., implicit racial bias); (c) provides opportunities for discovering new theories leading to breakthrough improvements; and (d) promotes the discovery of novel "practiced-based evidence," in contrast to just deploying and incrementally improving "evidence-based practice."

Examples of single and double-loop learning

Figure 17 depicts a well-known, historical example of single and double-loop learning with Olympic high jump performances [61]. Single-loop learning led to incremental improvements during the "Scissors" era. However, when a new theory of high jumping emerged (i.e., "Western Roll"), we witnessed breakthrough improvements, followed again by incremental improvements until new theories emerged ("Straddle," "Fossbury Flop"). Double-loop learning is powerful but requires awareness of its availability.

A modern example of single and double-loop learning are the incremental and breakthrough improvements in the prevention and treatment of human immunodeficiency virus (HIV) infection. Advancements in antiretroviral combination drug therapy have not only improved quality of life and survival to near full life expectancy, but has also decreased the serum viral load to such low levels that it has dramatically decreased virus transmission. Epidemiologically, the "community viral load" is similarly decreased and we now called this strategy "treatment as prevention." Similarly, for HIV-negative persons we offer pre-exposure prophylaxis (PrEP) to reduce the risk of acquiring HIV infection from an infected sexual partner. To learn more see "Getting to Zero San Francisco" at https://www.gettingtozerosf.org/.

By itself, PDSA is powerful. However, connected to vision, purpose, and strategy PDSA unleashes profound and far-reaching potential for achieving aspirational goals in the community and the organization. Professor Mike Rother calls this the "improvement kata" [62] and Eric Ries calls this "validated learning" [15].

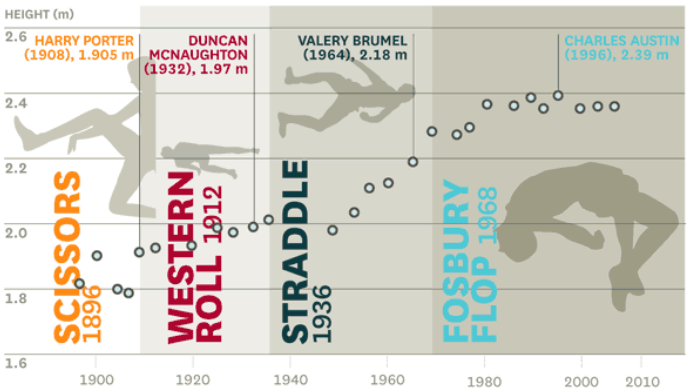


Figure 17. Olympic gold medal winners in the high jump (Olympic Games were not held in 1916, 1940, and 1944)

Validated learning: "PDSA cycles with a purposeful goal"

Professor Mike Rother, University of Michigan scholar of the Toyota Production System, acknowledges that many organizational lean transformations fail primarily because they adopt lean tools without transforming the culture [62]. Based on cognitive and behavioral science research he developed the *improvement kata*—a standardized approach to purpose-driven scientific problem-solving that drives behavior and transforms organizational culture. To align with lean startup (p. 40) we call this *validated learning*.

PDSA thinking, by itself, is not sufficient unless it (a) motivates daily experiments, (b) improves performance, (c) moves the organization towards its goals, (d) promotes coaching and teaching, and (e) creates a learning culture.

Validated learning (Figures 18–19) can be described as purposeful, goal-driven rapid cycle PDSA experiments, and it has four clear sequential steps:

1. embrace a **challenge** and set a **goal**,
2. grasp the **current condition**,
3. establish your **next target condition**, and
4. conduct **PDSA experiments** to get there (Figure 20).

A challenge is a problem, need, opportunity, goal, or assignment. Validated learning (Figure 20 on the next page) supports rapid PDSA cycle prediction, learning, and improvement.

These short YouTube training videos are must viewing:

- https://www.youtube.com/watch?v=3f5wxRO7EYM
- https://www.youtube.com/watch?v=4VwrUzIS9m8
- https://www.youtube.com/watch?v=uqZOu1D639Q

Coaching validated learning (5 coaching questions)

The coaching questions are asked with humility and genuine curiosity ("humble inquiry"). Here are preliminary questions: (a) Which True North metric? (strategic direction); (b) What is the challenge? (problem, opportunity, assignment); and (c) What is the goal? (yours or assigned) Here are the *five coaching questions*:

1. What is the (next) target condition?
2. What is the current (actual) condition?
3. What obstacles do you think are preventing you from reaching the target condition?
4. What is your next step (experiment)? What do you expect?
5. How quickly can we go and see what we have learned from taking that step?

These questions have been validated with adults and children, and are effective for developing scientific daily problem solvers.

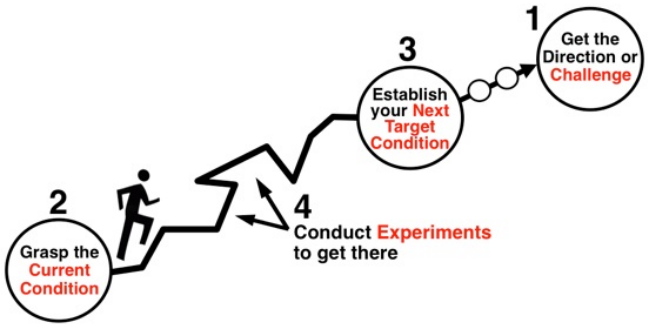


Figure 18. Validated learning (adapted from [15, 62])

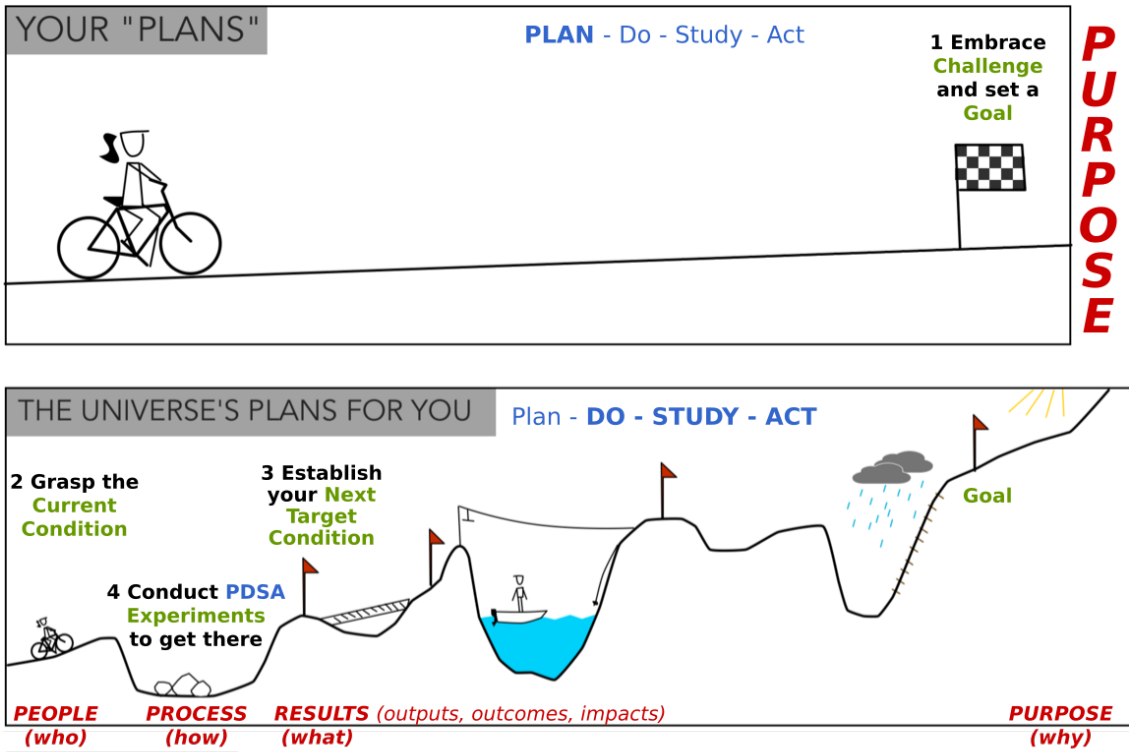


Figure 19. Validated learning is "PDSA with a purpose" (cartoon adapted from http://thedoghousediaries.com/5468)

Validated learning *(Each row = one experiment)* PDSA cycles

General hypothesis ("We believe ... ")		Process:	
		Learner:	Coach:
Date, step & metric	**What do you expect?**	**What happened**	**What we learned**

Do a Coaching Cycle | *Conduct the Experiment*

Figure 20. Validated learning (improvement kata) can be used alone or inserted into A3 reports at the Do-Study-Act steps.

A3 reporting: Problem solving on A3 paper

For needs or problems that are complex, or involve multiple stakeholders, we summarize the problem solving process on A3 paper (Table 6). Sections 1–5 are on the left side, and steps 6–8 are on the right side. A3 sections can be worked on in any order with one exception: the left side (sections 1–5) *must* be completed *before* the right side (sections 6–8). This ensures that proposed actions ("countermeasures") are not proposed until there is a thorough shared understanding of the current state, gap, and key drivers (causes). The PDSA activities from Table 5 (define, design, decide, predict, etc.) still apply, and in fact, they apply to all problem-solving frameworks, including design thinking, lean startup, decision making, etc.

The **Problem Statement** is a concise description of problem, need, or opportunity, and are classified as (a) *troubleshooting* (reactive problem solving), (b) *gap from standard* (structured problem solving), (c) *target condition* (continuous improvement), or (d) *open-ended* (innovative problem solving) [63]. The problem statement is a *conjecture* of what could be better, and an *estimate* of the size of the need or gap. The problem statement is updated—and may change significantly—as more is learned from the current state. A problem statement should be specific and not state causes or solutions.

The **Background** section is a summary of the context, and health and/or business rationale: (a) Why, why now, why should we care? (b) Who are the key stakeholders? (c) How does solving this problem align with vision, purpose, True North? (d) Does this A3 connect to a parent or children A3s? (e) What other analyses support this A3 (e.g., business case).

The **Current Condition** is a descriptive summary of the current state of the problem area. For qualitative data go to the Gemba to see and understand (genchi genbutsu). For quantitative data review process and results indicators from Table 10 on page 33, including trends and forecasts. Indicators will likely come from the True North metrics.[14] For population and/or performance indicators,[15] start with result indicators: (a) How much did we do? (quantity of outputs) (b) How well did we do it? (quality of outputs) (c) Is anyone better off? (outcomes of customers) Use lean tools[16] to describe, measure, and understand the value stream processes that drive results.

The **Goal and next Target Condition** section states the goals and targets, but focuses on the next target condition. The Golden State Warriors goal is to win the NBA Finals. Their first target condition is to earn a spot in the NBA playoffs. To get there they must play 80 regular season games. Each games is a PDSA cycle of prediction, learning, and improvement.

If a **shared goal** does not exist—which is very common—then we must design an inclusive, participatory, creative process to generate a goal ("common agenda") that everyone will support. Starting without a goal occurs when we are assigned a general "direction" without specific goals or targets. That's why this is the first step in the validated learning and results-based methods.

Table 6. A3 report: Problem solving on A3 paper

PDSA	Activity (Table 5)
Plan	
1. Problem Statement	Define
2. Background	⇓
3. Current Condition	⇓
4. Goal & next Target Condition	Design
5. Analysis (gap and root cause)	⇓
6. Proposed Actions (countermeasures)	Decide
Do	⇓
7. Action plan	Experiments[a]
Study and Act	Learn[b]
8. Validated learning (PDSA cycles)	Improve[c]

[a] Prediction, Experimentation, and Measurement

[b] Mindful observation, Reasoning, and Reflection

[c] Adoption, adaptation, or abandonment ("pivot or persevere")

The **Analysis** section summarizes the necessary analyses and/or syntheses to determine the proposed actions, and includes, but is not limited to: (a) gap analysis, (b) root cause analysis (see p. 26), and (c) decision quality (DQ) (see p. 42). Gap analysis measures the magnitude of the problem. Causal analysis must lead to a "theory of change" in order to design a "theory of action" (proposed actions). We use DQ methods when decision-making is the primary focus of the A3 (e.g., important strategic decisions).

The **Proposed Actions** ("countermeasures")[17] section summarizes the interventions (theory of action) that are hypothesized to activate a theory of change (strategy, change concept). A very useful approach is to draw a *driver diagram* that is a left-to-right expanding tree with the following nodes connected by right-to-left arrows: (a) outcome(s), (b) primary and secondary drivers (theory of causation), (c) change concepts (theory of change; strategy), and (d) proposed actions (theory of action). In contrast, for decision problems, the proposed actions would be the choices selected. Figure 21 on the following page displays a conceptual driver diagram from a review article worth reading [64].

The **Action plan** section is the high-level project schedule (e.g., *kaizen* workshops). For traditional projects it should be a Gantt chart, and for agile projects list proposed project phases recognizing that the specifics of the phases will change and evolve and as more is learned and integrated at each iterations. While project managers may keep detailed project plans, project teams may huddle at *kanban* project management boards [18].

The **Validated Learning** table (PDSA cycles) (Figure 20) can be used alone for experiments, or can fit as the Do-Study-Act section of an A3 report. Validated learning explicitly includes prediction, learning, and improvement cycles.

This A3 report and should be collaborative with diverse input. For A3 reports we recommend this Stanford training video: https://www.youtube.com/watch?v=rtyia0ci12I.

[14] (a) equity, (b) health impact, (c) service experience, (d) safety and security, (e) workforce experience, and (f) financial stewardship.

[15] See Results-Based Accountability™ (Section 11 on page 31)

[16] value stream, cross-functional, process, or spaghetti diagrams, etc.

[17] Using lean jargon. We prefer common language.

Reasoning with causal analysis and program theory

All problem solving, PDSA double-loop learning, and research requires causal thinking and analysis ("root cause analysis"). We then use the knowledge of causal pathways to select promising strategies and design specific interventions. Collectively, causal pathway + strategy + intervention is called *program theory* [65]:

(a) Th. of *causation* (causal pathway; e.g., exposure to infection)
(b) Th. of *change* (promising strategy; e.g., herd immunity)
(c) Th. of *action* (specific intervention; e.g., vaccination)

Before we intervene, what is our underlying causal assumption (theory of causation)? For example, the tobacco industry used advertisements to target youth and induce them to "smoke" electronic cigarettes. What change strategy will we select (theory of change)? For example, we might select changing "social norms" as our behavioral change strategy. What specific intervention will we deploy to activate our theory of change (theory of action)? For example, we might select to launch a "social marketing" campaign to change social norms around e-cigarettes.

Whether stated or not, *all public health interventions have a program theory* (theory of causation, change, and action). Our program theory should be stated clearly and make intuitive sense to primary stakeholders, including our staff.

When we do not have a theory of causation we must conduct a "root cause analysis." We have five common methods:

(a) five whys (and five hows) [66],
(b) force-field analysis,[18]
(c) fishbone (Ishikawa) diagram,[19]
(d) driver diagram (Figure 21) [64], and
(e) causal graphs (directed acyclic graph, causal loop diagram)

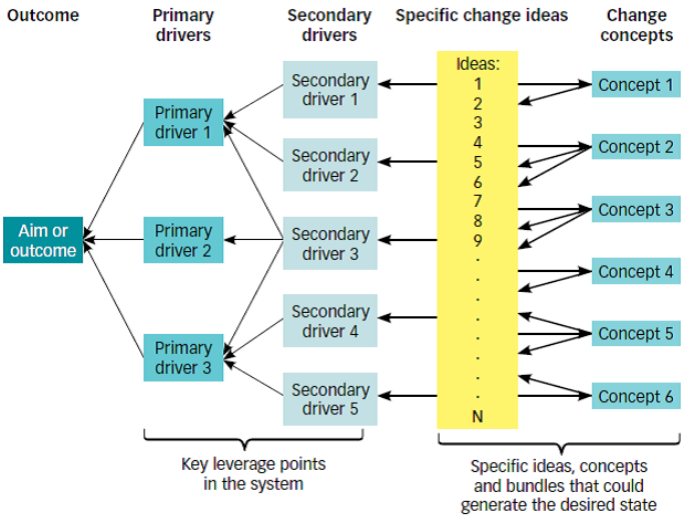


Figure 21. Driver Diagram [64]: think of "primary" and "secondary" drivers as the root causes (theory of causation), "change concepts" as theory of change, "specific change ideas" as theory of action that are tested (PDSA experiments). Together, theories of causation, change, and action are program theory.

[18] https://www.mindtools.com/pages/article/newTED_06.htm
[19] http://asq.org/learn-about-quality/cause-analysis-tools/overview/fishbone.html

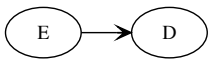
The five whys, force-field analysis, fish-bone diagrams are easy to deploy and effective for brainstorming on causes (risk and protective factors), solutions, and barriers. A fish-bone diagram groups causes into categories: measurement, materials, people, environment, methods, and machines.

For important problems we develop a driver diagram or causal graph where individual causal links are based on evidence or logic. Driver diagrams (Figure 21) are effective and support program theory, quality improvement, collective impact (p. 30), and Results-Based Accountability™ (p. 31).

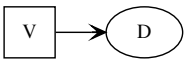
Causal graphs encode expert knowledge: scientific evidence (literature), practice-based evidence (your PDSA experiments), and community evidence (accumulated knowledge, wisdom, and lived experience). A causal graph is a "knowledge expert system." We will cover directed acyclic graphs and causal loop diagrams.

Causal graph 1: introducing the directed acyclic graph (DAG)

We use directed acyclic graphs (DAGs) or causal loop diagrams (CLDs). DAGs do not have feedback loops, CLDs do.[20] CLDs are good for depicting complex systems ("systems thinking") (see p. 29). In this DAG, disease (D) is caused by exposure (E) to an infectious agent.



Now suppose we have a vaccine (V). If we conduct a randomized control trial, this would be the new DAG:



However, the more common public health practice scenario is that we have a vaccine that we promote and subjects *volunteer* to get vaccinated. We want to know if the vaccine works, but we are concerned that those who select to get vaccinated differ from those who do not select to get vaccinated with respect to exposure status (E). E is a "confounder." Here is the DAG to test vaccine effectiveness; we need to control for confounding by E:

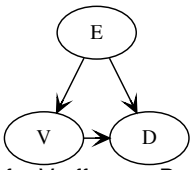


Figure 22. DAG for V effect on D, confounded by E

Figure 22 depicts the three key DAG patterns:

(a) *chain* (sequential cause): E→V→D,
(b) *fork* (common cause): V←E→D, and
(c) *collider* (common effect): V→D←E.

DAGs can represent very complex causal pathways that can include diverse stakeholder input. The lack of an arrow between nodes is the strongest assertion ("unconditional independence") and often can be supported by logic alone ("carrying matches does not cause lung cancer"). Data scientists use DAGs to design appropriate statistical models to test causal links, to adjust for confounding, and to not introduce confounding [67, 68].

[20] DAGs can incorporate feedback by drawing time-dependent nodes.

Reasoning: correlation does not imply causation, and more!

The central question with performance improvement is whether our intervention works? It is not always feasible to conduct randomized experiments.[21] Therefore, we must design an intervention so that we can test it using observational (non-experimental) methods. This requires sharpening our **causal reasoning** skills.

Consider two variables, X and Z. What can explain an association (correlation) between X and Z?

(a) direct cause: $X \rightarrow Z$
(b) reverse cause: $X \leftarrow Z$
(c) cyclic cause (causal loop): $X \leftrightarrows Z$
(d) pure coincidence (chance only): X not connected to Z

That was straightforward. Moving forward, we set aside chance.

Our reasoning gets tricked when X and Z are both connected to a third variable Y. What can explain an association (correlation) between X and Z? There are *only three* possible explanations:

(a) *chain* (sequential cause): $X \rightarrow Y \rightarrow Z$ ("causation"),
(b) *fork* (common cause): $X \leftarrow Y \rightarrow Z$ ("confounding"), and
(c) *collider* (common effect): $X \rightarrow \boxed{Y} \leftarrow Z$ *when conditioning on* Y ("collider bias," "endogenous selection bias" [69]).

Chains and forks make intuitive sense, colliders do not: X and Z, are obviously independent (not associated); however, when we condition on Y they become associated ("conditionally dependent"). The key danger is that when we start "adjusting for potential confounders" we risk introducing spurious associations that we might conclude are causal! This is a humongous no-no!

Here is the classic example of *collider bias*. We flip a fair coin twice $\{0 = \text{tail}, 1 = \text{head}\}$. T_1 is the outcome of the first coin flip $\{0,1\}$; T_2 is the outcome of the second coin flip $\{0,1\}$; and S is sum of T_1 and T_2 $\{0,1,2\}$. Here is the DAG:

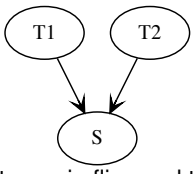


Figure 23. DAG for two coin flips and the number of heads

Knowing the value of T_1 tells us absolutely nothing about the value of T_2, and vice versa. They are completely independent (represented by no connection in the DAG). However, if we are told the value of S (say, 1) (this is "conditioning"), then T_1 and T_2 are now dependent. If $T_1 = 0$, then we know the value of T_2 must be 1. If $T_1 = 1$, then we know the value of T_2 must be 0. The reverse is true: knowing T_2 informs us of the value of T_1. For an epidemiologic example see Cole [70].

Our motivation for introducing DAGs, etc. is to emphasize that our reasoning is very vulnerable—even when we have data! It is easy to be enamored by sophisticated statistical modeling. Do not be fooled! Be intellectually accountable! *For starters, ask your staff to describe the program theory for important interventions*. If we cannot describe the program theory, then how on earth do we expect to improve it? We will be flying blindly. Data scientists will help translate program theory into DAGs.

[21] When you can conduct an experiment—just do it!

Causal and evidential reasoning: introducing Bayes theorem

Up to now we have focused on causal reasoning: does our intervention improve an outcome? Does exposure cause disease? Now we will take a causal link as given (causal reasoning), and ask the reverse: given disease, did the exposure occur (evidential reasoning)? How likely is our hypothesis given the evidence?

We apply evidential reasoning every time we conduct a diagnostic test, so we start here, but the concepts apply widely. It's critical to understand *both* causal *and* evidential reasoning.

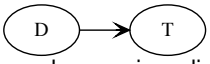


Figure 24. DAG for causal reasoning: disease (D) and test (T)

Diagnostic tests work because diseases (D) "cause" test results (T). Figure 24 captures this established causal reasoning, as does factoring the joint probability (Equation 1):

$$\Pr(D \text{ and } T) = \Pr(D)\Pr(T \mid D) \tag{1}$$

When a patient has symptoms and we suspect a disease (hypothesis), we are interested in knowing $\Pr(D \mid T)$: what is the probability of disease status (hypothesis) given test results (evidence)—this is **evidential reasoning**, represented by flipping the arrow (note: using dotted arrow for non-causal influence):

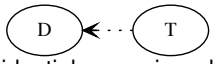


Figure 25. DAG for evidential reasoning: disease (D) and test (T)

Figure 25 captures this evidential reasoning, as does factoring the joint probability (Equation 2):

$$\Pr(T \text{ and } D) = \Pr(T)\Pr(D \mid T) \tag{2}$$

From probability theory, $\Pr(T \text{ and } D) = \Pr(D \text{ and } T)$, and we can derive—the one and only—**Bayes Theorem** [71–73]!

$$\Pr(D \mid T) = \frac{\Pr(D)\Pr(T \mid D)}{\Pr(T)} \tag{3}$$

We are actually interested in the positive predictive value or PPV. We can transform Equation 3 into Equation 4 where $\Pr(T+ \mid D+) =$

$$\frac{\Pr(D+)\Pr(T+ \mid D+)}{\Pr(D+)\Pr(T+ \mid D+) + \Pr(D-)\Pr(T+ \mid D-)}, \tag{4}$$

where $\Pr(D+)$ is the prior probability of disease, $\Pr(T+ \mid D+)$ is the test *sensitivity*, and $\Pr(T- \mid D-)$ is the test *specificity* [71,72].

Now we can calculate $\Pr(D+ \mid T+)$, the probability of disease (hypothesis) given a positive test (evidence), taking into account the test operating characteristics (sensitivity, specificity), and the prior probability of disease (first estimate comes from prevalence data). With the help of data scientists, Bayes Theorem and causal and evidential reasoning can be applied to complex DAGs. It is critical to recognize today's computational ability to exploit these Bayesian expert systems to our advantage. Otherwise we are susceptible to invalid inferences, biases, and poor decisions. Everything starts with intellectual humility, honesty, and courage.

Public health example using directed acyclic graphs

In public health we have two common DAG archetypes: a risk (adverse) event and a benefit (opportunity) event (Figure 26). For both, a trigger is an exposure, condition, activity, or incident that increases the probability of a risk or benefit event. A trigger can be a cumulative process. Before an intervention, these DAGs represent the theory of causation component of program theory.

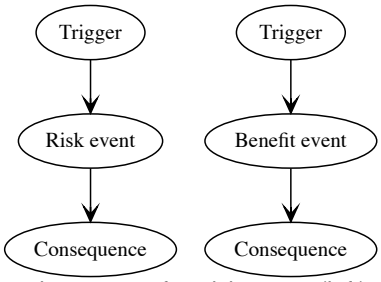


Figure 26. Causal taxonomy for "risk" event (left) vs. "benefit" event (right) (source: adapted from [68]).

Figure 27 depicts the program theory for a public health intervention to reduce automobile crash injuries (a risk event). The theory of change has three strategies (prevention, control, and mitigation), and the theory of action has three interventions (speed bumps, automatic breaking, and seat belts).

In a risk-event outcome (consequence), the 5 whys of root-cause analysis move backwards: Why was there an injury? Because of a crash. Why was there a crash? Because of fast driving? Why was there fast driving? We cannot answer this question (yet).

The program theory is not complete. We must also understand why people drive fast. We have not included the theory of causation from drivers' perspectives. Suppose, for instructional purposes, Figure 28 represents the most common DAG that explains why drivers speed. Therefore, why was there fast driving? To make a meeting. Why was this meeting important? To win a contract? Why was this contract important? (unemployment?)

We can now really appreciate the importance of evaluating multiple perspectives. For example, the motivation to drive fast might cancel out the effect of any traditional public health intervention (Figure 27). We must be able to integrate multiple causal pathways reflecting multiple perspectives.

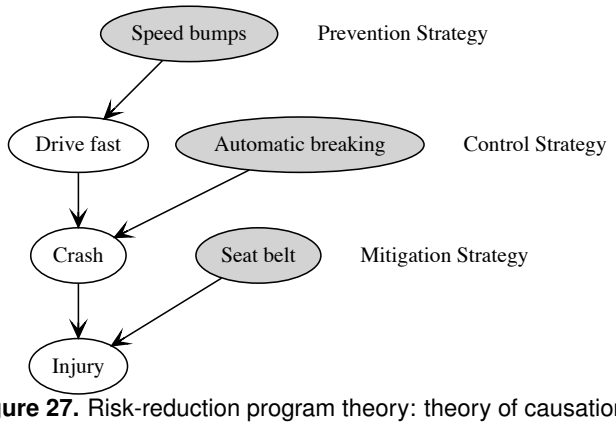


Figure 27. Risk-reduction program theory: theory of causation, theory of change (strategy), and theory of action (intervention)

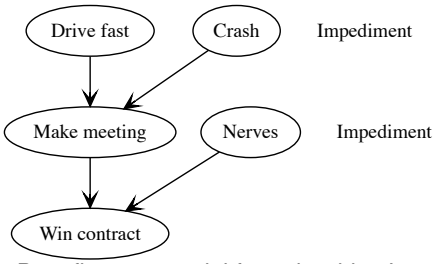


Figure 28. Benefit-event model from the driver's perspective.

Figure 29 depicts the unified DAG that integrates driver motivation into a holistic, improved public health program theory. We cannot emphasize enough the importance of building causal graphs from multiple perspectives that include risks and benefits, and different strategy levels. This DAG is a big improvement.

However, when you review it with subject matter experts they suggest adding "gender" and "age" nodes because both are causally associated with driving fast and wearing seat belts (Figure 30). This will enable you to evaluate the effectiveness of the public health intervention while controlling for the confounding effects of gender and age. For example, if drivers are predominately young males (who drive fast and do not wear seat belts) then the seat belt intervention may appear falsely ineffective. These DAGs encode expert and community knowledge and wisdom, and are used for causal, evidential, and decision reasoning.

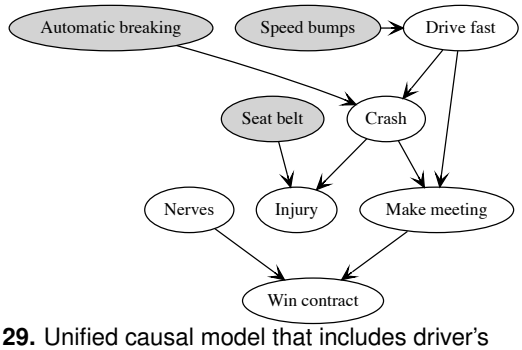


Figure 29. Unified causal model that includes driver's perspective (benefit-seeking) and program theory (risk-reduction).

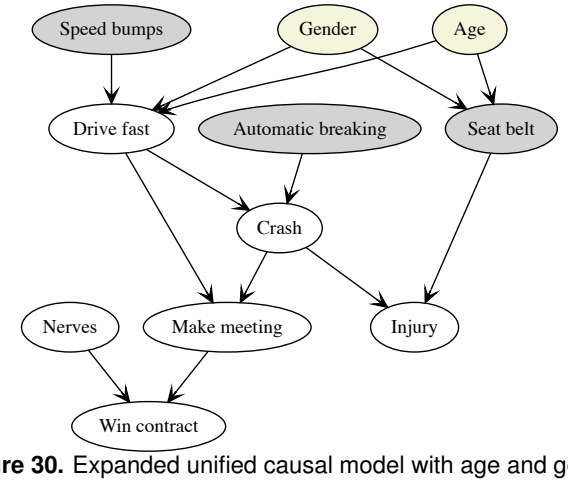


Figure 30. Expanded unified causal model with age and gender

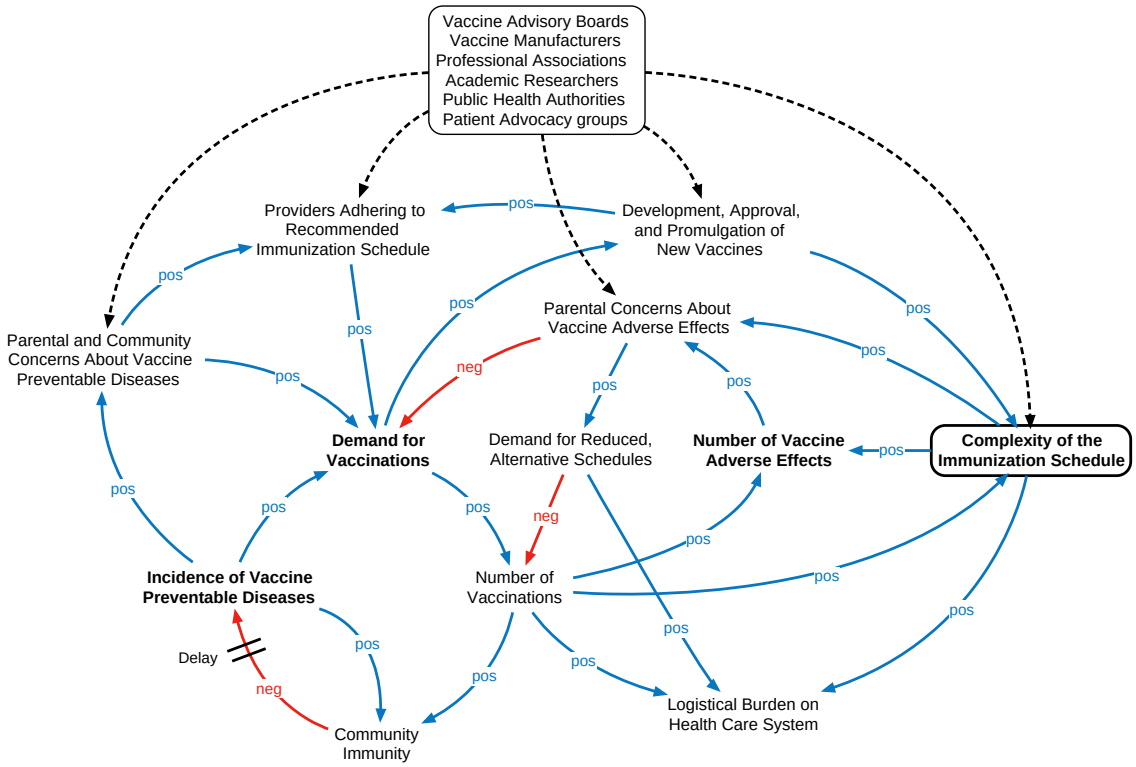


Figure 31. The United States vaccination-health system: A complex adaptive system with a complex intervention (vaccine schedule)

Causal graph 2: Causal loop diagrams for systems thinking

Up to now we have focused on directed acyclic graphs (DAGs) as our first type of causal graph. Thinks of DAGs as a complex network of one-way causal links with the *flow of probabilities*.[22] Because DAGs do not have feedback loops, we are able to build up and deploy complex causal pathways as knowledge expert systems amenable to "what if" analyses by data scientists.

In contrast to DAGs, a causal loop diagram is a complex network of causal influences where each node is a quantity of something (e.g., number of infectious cases). When the quantity of one node changes (up or down) it causally influences the quantity of a connected node (up or down). A causal loop has two nodes with two connections. If the change in quantity of both nodes move in the *same direction* (up or down) the causal influence is "positive." If the change in quantity of both nodes move in the *opposite direction* the causal influence is "negative."

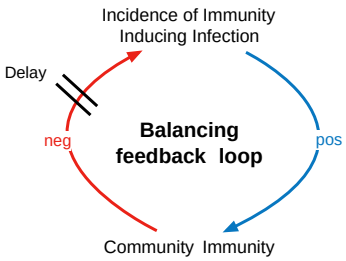


Figure 32. Example of balancing feedback loop involving immunity-inducing infection and population herd immunity.

[22] Marginal probabilities (e.g., $\Pr(E)$) or conditional probabilities (e.g., $\Pr(D \mid E)$)

A causal loop between two nodes can result in either a balancing loop or a reinforcing loop. A *balancing loop* has one positive arrow and one negative arrow (Figure 32). Like a thermostat, balancing loops drive towards stability. A *reinforcing loop* has either two positive arrows or two negative arrows. In contrast to balancing loops, reinforcing loops drive towards higher and higher quantities (negative or positive). A reinforcing loop accelerates or amplifies a process, and can spiral out of control into instability and danger. To learn more study Peter Senge [74].

Using both feedback loops we can draw complex system maps (Figure 31) to gain a deep conceptual understanding of the forces driving a system problem, and to use it for problem solving.

For example, we developed a systems map (Figure 31) while serving on a committee to understand how the vaccine schedule is driving parental concerns [75]. The U.S. vaccination-population health system is a complex adaptive system with diverse entities that are connected, interdependent and adapting through feedback loops. *Emergent* properties of a system can only be observed empirically from the interaction of components, and are not properties of individual components. For example, the transmission dynamics of a microbial agent in human populations is an emergent property: it is dependent on the prevalence of infectious persons, duration of infectiousness, the prevalence of susceptible persons, contact with susceptible persons, microbe transmissibility, host susceptibility, and microbial virulence.

Community immunity, the collective immunity of a population, is an emergent property that includes the indirect protection from immunized persons, whether by vaccination or natural infection, that benefits both unvaccinated and vaccinated persons.

11. Collective impact (results-based) methods

Lean evolved out of production systems. In contrast, results-based methods (RBMs) are frameworks for mobilizing partners to tackle community health challenges [12, 13]. RBMs start by convening stakeholders and building a shared vision and setting goals. Using ends-to-means causal-thinking, we design strategies that are informed by gap and root-cause analyses, evidence-based solutions, and community voice. By aligning, coordinating, and improving existing efforts we pursue collective impact.

Collective impact framework

Collective impact is a collaborative, multi-sector approach to address complex social problems [76–79]. FSG.org defines collective impact as "the commitment of a group of important actors from different sectors to a common agenda for addressing a specific social problem at scale." Collective impact promotes an adaptive, continuous improvement, and growth mindset (Table 7).

Collective impact fulfills five conditions [76]:

1. common agenda (goals),
2. shared measurement (results and process indicators),
3. mutually-reinforcing activities (interdependent processes),
4. continuous communication (relational processes), and
5. backbone support (strategic project management).

Principles of Practice

Collective impact promotes the Principles of Practice:[23]

1. Design and implement with a priority placed on *equity*.
2. Include *community* members in the collaborative.
3. Recruit and co-create with *cross-sector partners*.
4. Use data to continuously *learn, adapt, and improve*.
5. Cultivate *leaders* with unique system leadership skills.
6. Focus on *program* and *system strategies*.
7. Build a culture that fosters *relationships, trust, and respect*.
8. *Customize* for local context.

Five core conditions of collective impact

[1] Common agenda: A common agenda is having a shared vision and common goals. The prerequisite to a common agenda is having trust between community partners. This takes time and cannot be rushed.

[2] Shared measurement: A shared measurement system enables partners to answer: How do we measure and predict success? They must select common result indicators. The real innovation occurs when they use value stream mapping, and other lean tools, to improve cross-cutting, interdependent processes that touch multiple organizations.

[3] Mutually-reinforcing activities: Partners come to the table with activities that are inspired by their organizational purpose and mission. They come already inspired! We do not ask them to stop what they are doing, but rather to start by aligning and coordinating their activities.

[23] https://collectiveimpactforum.org/

Table 7. Complex social change requires a shift in mindset *from* technical (complicated) *to* adaptive (complex) problem-solving

Technical problem-solving	*Adaptive* problem-solving
Technical solutions	Adaptive solutions
Evidence	Evidence *and* relationships
Content expertise	Content *and* context expertise
One solution	Many coordinated solutions
Credit is concentrated	Credit as shared currency

[4] Continuous communication: Continuous communication is focused on building trust and cooperation among diverse partners and communities. This requires deploying team building skills (see Appendix A: Building Effective Teams on p. 10).

[5] Backbone support: Collective impact requires a robust backbone support infrastructure. The backbone is a multidisciplinary team skilled in strategic project management, neutral facilitation, collective decision-making, and continuous improvement. Here are the key functions from [78]: (a) guide vision and strategy, (b) support aligned activities, (c) establish shared measurement practices, (d) cultivate community engagement and ownership, (e) advance policy, and (f) mobilize resources. We believe backbones should have support in strategic, agile project management, performance improvement, data science, and program evaluation.

Backbones must balance the tension between coordinating and maintaining accountability, while staying "behind the scenes" to promote collective ownership. The backbone does not set agendas, drive solutions, receive all the funding, or appoint itself. However, for the initiative to succeed, backbones must be adequately funded, supported, and continuously trained.

Collective impact embraces complexity

Collective impact embraces complexity: community health and social problems and solutions emerge from complex adaptive social systems. Complex systems are defined as diverse entities that are connected, interdependent, and adapting [80]. Communities and organizations are complex systems, and they are dynamic and often unpredictable. Off-the-shelf solutions do not exist for complex social problems: stakeholders experiment and iterate to solutions that work in their local context. Failure and learning are the rule. Table 8 summarizes the difference between simple, complicated, and complex problems. Complex problems do not have known and agreed-upon root causes and/or solutions.

Table 8. Simple, complicated, and complex problems

Problem	Known and agreed-upon root cause	Known and agreed-upon solution	Solution feasible without external expert assistance
Simple	Yes	Yes	Yes
Complicated	Yes	Yes	No
Complex	Yes or No	No	No

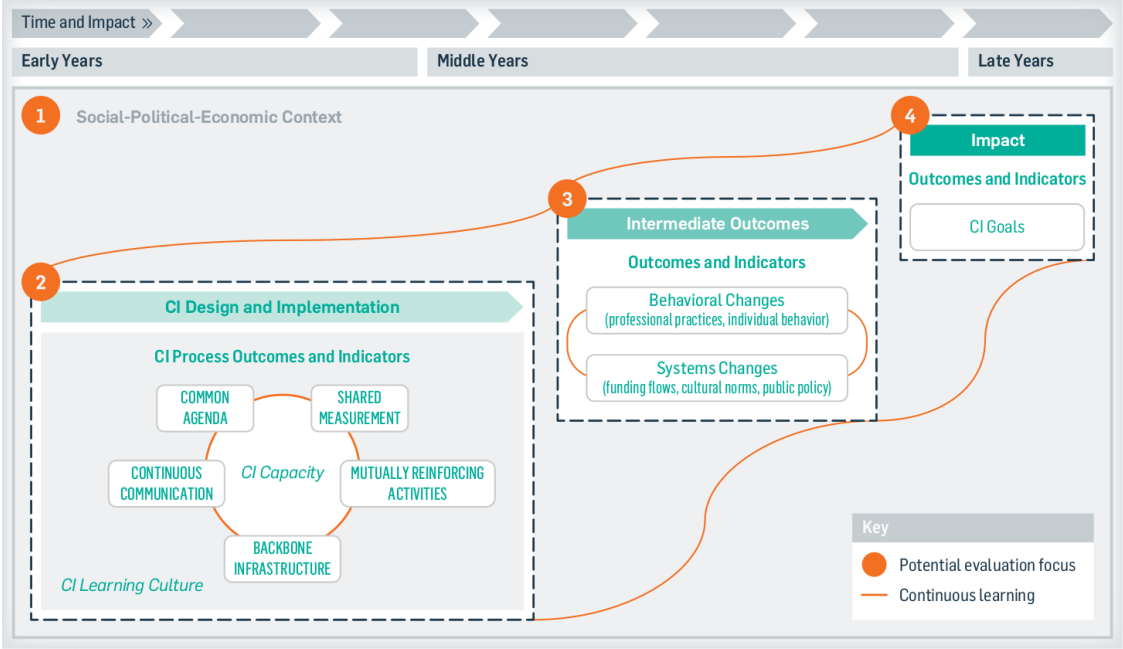


Figure 33. An evaluation framework for a collective impact initiative (source: http://collectiveimpactforum.org)

The role of evaluation

Collective impact uses *both* shared measurement *and* evaluation to understand their effectiveness and impact. **Evaluation** includes formative, summative developmental methods.

Formative evaluation is an evaluation that takes place before or during a project's implementation with the aim of improving the project's design and performance. The focus is on learning, adaptation, and continuous improvement. The evaluation complements summative evaluation and is essential for understanding why a program works or doesn't, and what other factors (internal and external) are at work during a project's life.

"*Summative evaluation* occurs at the end of a program cycle and provides an overall description of program effectiveness. Summative evaluation examines program outcomes to determine overall program effectiveness."[24]

"*Developmental Evaluation* supports innovation development to guide adaptation to emergent and dynamic realities in complex environments. Innovations can take the form of new projects, programs, products, organizational changes, policy reforms, and system interventions. . . . [In a complex system] patterns of change emerge from rapid, real time interactions that generate learning, evolution, and development—if one is paying attention and knows how to observe and capture the important and emergent patterns. Complex environments for social interventions and innovations are those in which what to do to solve problems is uncertain and key stakeholders are in conflict about how to proceed" [81].

The **shared measurement system** (SMS) uses a common set of indicators to monitor an initiative's performance and track progress. A SMS can be both an input to evaluation (by providing data and/or shaping evaluation questions) and an object of evaluation (Figure 33). SMSs promote improvement and accountability.

[24] http://toolkit.pellinstitute.org/evaluation-101/evaluation-approaches-types/

Results-Based Accountability™

Collective impact is continuous improvement applied at a social scale. The continuous improvement approach we recommend is **Results-Based Accountability™** (RBA) [13]—a results-based framework for improving communities for families and children. RBA is an epidemiologic framework for guiding a collective impact initiative. RBA complements lean. RBA emphasizes:

- Aspirational, **outcomes focus** ("Is anyone better off?")
- Framework for **designing and selecting indicators**
- **Root cause analysis** ("What's the story behind the curve?")
- Decision criteria for **selecting promising, effective strategies**

In public health the goal is to improve the health of communities (*population accountability*) by "ensuring the conditions in which people can be healthy" [32]. When we directly serve a customer (in a program, agency, or service system) the goal, again, is to improve their health (*performance accountability*). Therefore, *performance improvement contributes to population health improvement, but they are not the same* (Figure 34).

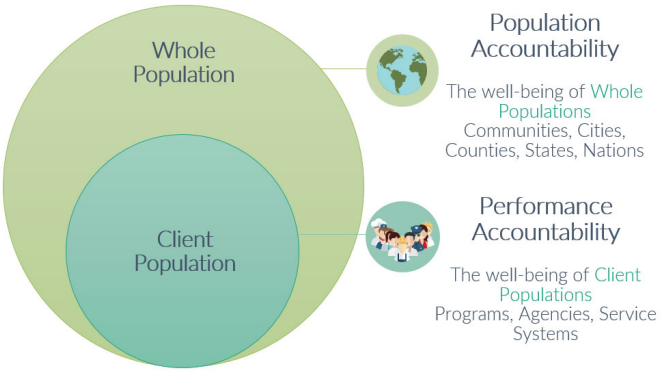


Figure 34. Results-Based Accountability™

In collective impact, *population accountability is shared by partners*, each of whom have *direct* performance accountability for their program, agency, or service system.

Start by engaging stakeholders with **7 strategic questions** (7SQ).[25] These 7SQ apply to both community health (population accountability) and client health (performance accountability).

1. What are we trying to *accomplish and why*? (**goals**)
2. How do we **measure and predict success**? (a) How are we doing with **result** indicators (outputs and outcomes for population or performance accountability); (b) How are we doing with **process** indicators?; and (c) For each, what is the *baseline* trend and *forecast*? (see Table 10 on the next page)
3. What are the **drivers**? (theory of causation; root causes)
4. What **partners** can help? (collective action and impact)
5. What **other conditions** must exist? (assumptions and risks)
6. What **strategies** work? (theory of change based on scientific and community evidence)
7. How do we *get there*? (**proposed actions** [theory of action], action plan; and validated learning)

Mark Friedman [13] uses slightly different questions (Table 9) where questions 4–7 apply to both columns. The **RBA Guide** [83] contains a 6-question set: (1) What is the "end"? (2) How are we doing? (3) What is the story behind the baseline curve? (4) Who are partners who have a role to play in turning the curve? (5) What works to turn the curve? (6) What do we propose to do to turn the curve? Use the set of questions that best fits your audience.

RBA has three essential questions for developing and monitoring performance improvement indicators (study Table 10). (1) *How much* did we do? (2) *How well* did we do it? and (3) Is anyone *better off*? Memorize and use these questions often.

Table 9. Collective impact questions from Results-Based Accountability.™ Questions 4–7 apply to both. (Source: [13])

	Population Accountability (see Figure 35)	Performance Accountability (see Figure 36)
1	What are the quality of life conditions we want for the children, adults, and families who live in our community?	Who are our customers? (clients, patients, businesses, staff)
2	What would these conditions look like if we could see them?	How can we measure if our customers are better off?
3	How can we measure these conditions?	How can we measure if we are delivering services well?
4	How are we doing on the most important of these measures? What is the story behind the curve?	
5	Who are the partners that have a role to play in doing better?	
6	What works to do better, including no-cost and low-cost ideas?	
7	What do we propose to do?	

[25] The 7SQ were derived from the "4 Critical Strategic Questions" [82].

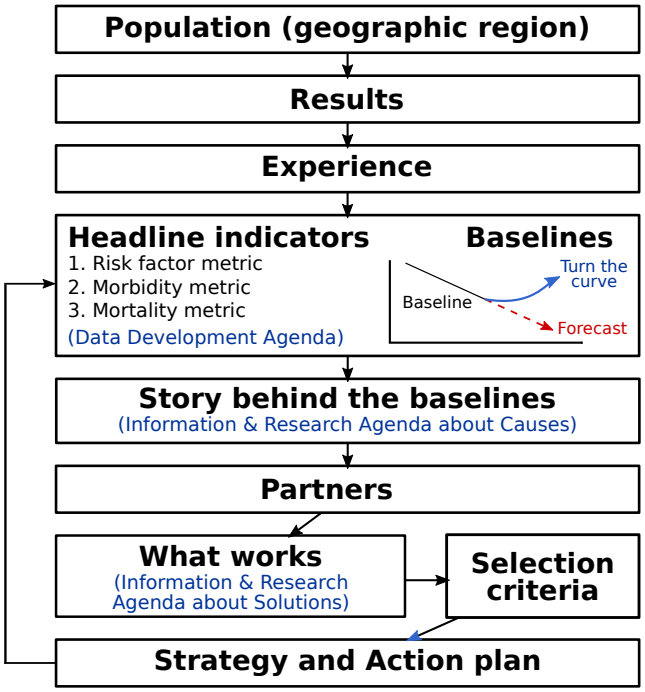


Figure 35. Population accountability (adapted from [13]) is applied to a collaborative partnership of programs, agencies, or service systems working collectively to impact population health improvement. Performance accountability (Figure 36) contributes to population accountability.

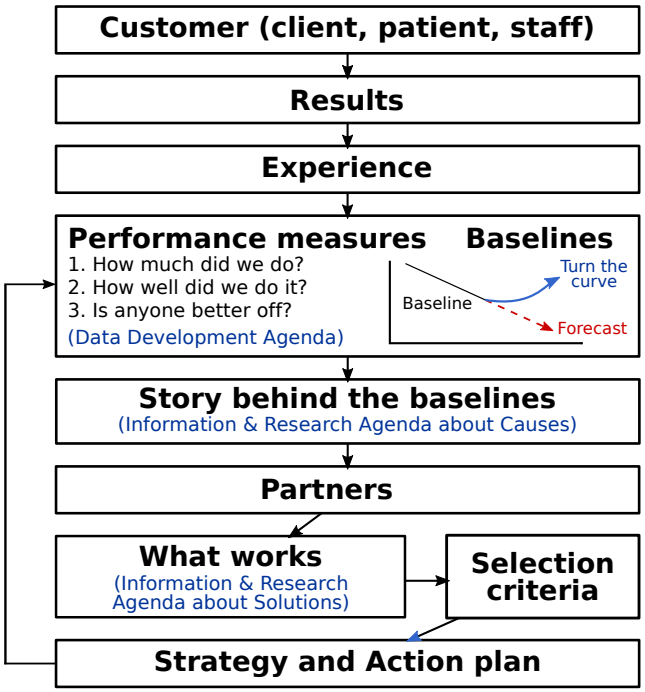


Figure 36. Performance accountability (adapted from [13]) is applied to a single program, agency, or service system. Performance improvement contributes to population health improvement (Figure 35). Figure 37 displays how performance accountability connects to population accountability.

Table 10. Population health, epidemiologic indicator framework for lean and collective impact (results-based) methods (e.g., Results-Based Accountability™). Focus on, act on, and improve *lead indicators* (processes and outputs) to improve *lag indicators* (outcomes). Lead indicators reflect processes under our *control* and are *causally predictive* of the outcomes.

	Performance indicators (partner, program, agency, or service system level)		
			Population health indicators (community level)
	Lead indicators (effort)		**Lag indicators** (effect)
	Processes	Results (outputs, outcomes)	
		Outputs	Outcomes (*3. Is anyone better off?*)
Quantity	*1. How much did we do?*		Circumstances (social & physical environments)
	Cycle and lead times	average wait	Knowledge, attitudes, beliefs, skills, satisfaction
	Value- & non-value-added times	# on schedule	Risk and protective factors
	Variation and mura (unevenness)	# services met standard	Health and wellness measures
	Muda (waste),[a] muri (overburden)	# clients served at standard	Disease, injury, disability, or death measures
Quality	*2. How well did we do it?*		Circumstances (social & physical environments)
	Cycle and lead times	average wait	Knowledge, attitudes, beliefs, skills, satisfaction
	% Value- & non-value-added times	% on schedule	Risk and protective factors
	Variation and mura (unevenness)	% services met standard	Health and wellness measures
	Muda (waste),[a] muri (overburden)	% clients served at standard	Disease, injury, disability, or death measures

[a] For 8 wastes in lean remember TRIM WOOD: transport, resource/talent mismatch, inventory, motion, waiting, over-processing, overproduction, and defects. Resource/talent mismatch occurs when a technical or human resource capability does not match its intended purpose. For example, a physician doing data entry, or using an expensive software "solution" when a manual, low-cost, process is sufficient. Untapped staff talent or potential is an example of resource mismatch.

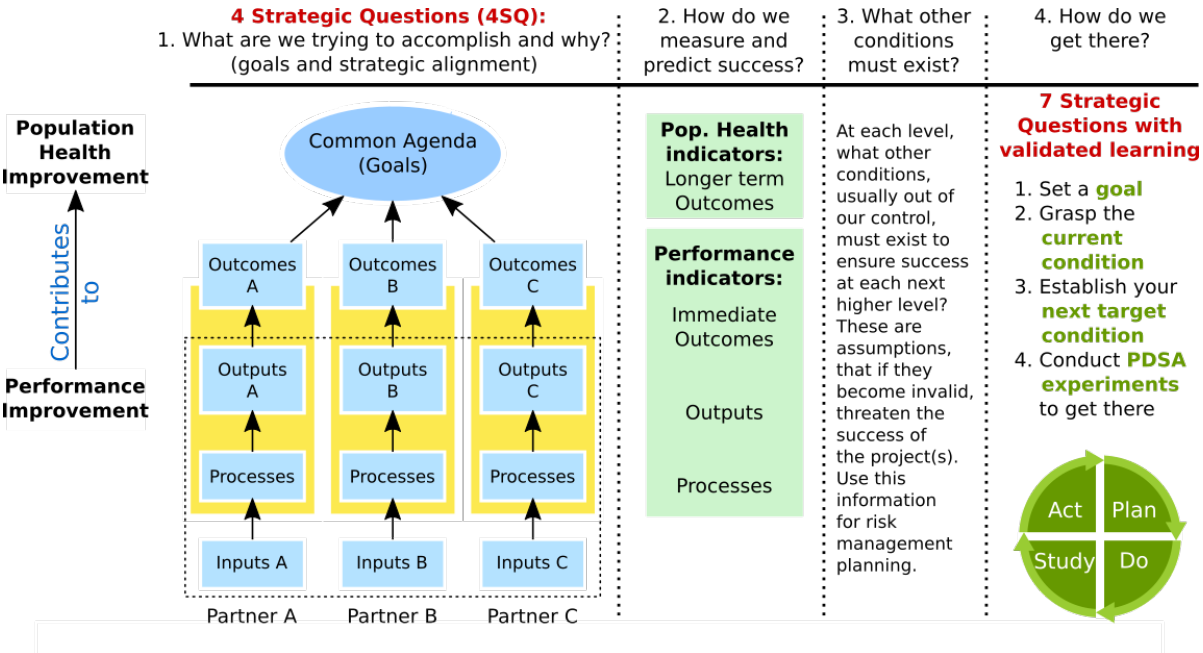


Figure 37. Results matrix: An epidemiologic, results-based systems framework for collective impact (e.g., Partners A, B, and C). The 4SQ depicts an overview; however, use 7SQ (or equivalent questions) and validated learning to implement RBMs. Partners' performance improvements—by improving processes that improve outputs that influence immediate outcomes—contribute to population health improvements in the community. Dotted-lined box outlines components under our full control: inputs, processes, and outputs. Use "What other conditions must exist?" to assess and challenge assumptions and risks, and to plan risk management.

Using the 7 Strategic Questions

For collective impact, the 7SQ can be summarized in an A3 report (Table 11). Define the population to be impacted by the collective impact initiative: community, client, or both. Population accountability applies to a **community population** that is not well enumerated and not served directly (e.g., men-who-have-sex-with-men (MSM) exposed to an HIV prevention social marketing campaign). Performance accountability applies to a **client population** served directly in a program, agency, or service system. A backbone facilitator poses the 7SQ (or equivalent) to a group of stakeholders. Preliminary planning questions include: Who are the primary customers? Who is the priority population?

[7SQ-1] What are we trying to accomplish and why? (goal)

The "why" refers to the strategic intent that is usually communicated by the vision, purpose, mission, or true north. Our **Goal Statement**[26] is "what" we are trying to accomplish: it is a positive, aspirational statement of health and well-being for community or client population. Try asking "What are the quality of life conditions we want for the children, adults, and families who live in our community?"

[7SQ-2] How do we measure and predict success? (current state)

If the goals were realized, what would it look like? Try asking "What would these conditions look like if we could see them?" "How can we measure if our customers are better off?" Our objectives are to (a) select process and result indicators, (b) evaluate past and current trends, and (c) and forecast future trends.

We must distinguish between *process*, *output*, and *outcome* indicators. Communities are inspired and mobilized by improving results (outcomes and outputs)—hence, the power of RBA. However, *to achieve results, we must improve processes*—hence the power of lean. Process and output indicators are also called *lead indicators* because they are (a) *causally predictive* of outcomes, and (b) *under our control*. Outcomes are *lag indicators*.[27]

> *The key to improving outcomes (lag indicators) is to improve processes and outputs (lead indicators).*

CAUTION: Lean experts are quick to warn us of the dangers of focusing solely on results (outputs and outcomes). To improve outcomes we increase the quantity and quality of our outputs (How much did we do? How well did we do it?). This seems so logical and, in fact, leads to improved outcomes. Results-oriented behaviors and successes are incentivized and rewarded. However, this can come at a great expense: when we are overly focused on results we are more likely *to lose focus on improving processes*. This leads to waste and inefficiencies. We focus on working harder, not necessarily smarter. We work longer hours and weekends, we hire more staff, we hire more consultants, we "troubleshoot" instead of problem-solve root causes, and we advocate for more resources and funding. We "throw money at the problem." We "do whatever it takes" to deliver results. This approach is not sustainable, especially when resources are scarce or others have a competitive advantage.

[26] In RBA, this is called the "Results Statement." For us, achieving results (outputs, outcomes) does not guarantee achieving goals.

[27] Sometimes immediate outcomes are used as lead indicators; for example, "test of cure" in the antibiotic treatment of female chlamydia infections. The lag indicators would be rates of pelvic inflammatory disease and infertility (longer term outcomes).

Table 11. A3-CI: Results-based collective impact on A3 paper

7 Strategic Questions	Activity (Table 5)
Plan	
1. Goal statement (common agenda)	Define
2. Current state (shared measurement)	⇓
3. Drivers (theory of causation)	⇓
4. Partners (collective action)	Design
5. Assumptions (external risks)	⇓
6. Strategies (theory of change)	Decide
Do	⇓
7. Action plan (theory of action)	Experiment[a]
Study and Act	Learn[b]
8. Validated learning (PDSA cycles)	Improve[c]

[a] Prediction, Experimentation, and Measurement

[b] Mindful observation, Reasoning, and Reflection

[c] Adoption, adaptation, or abandonment ("pivot or persevere")

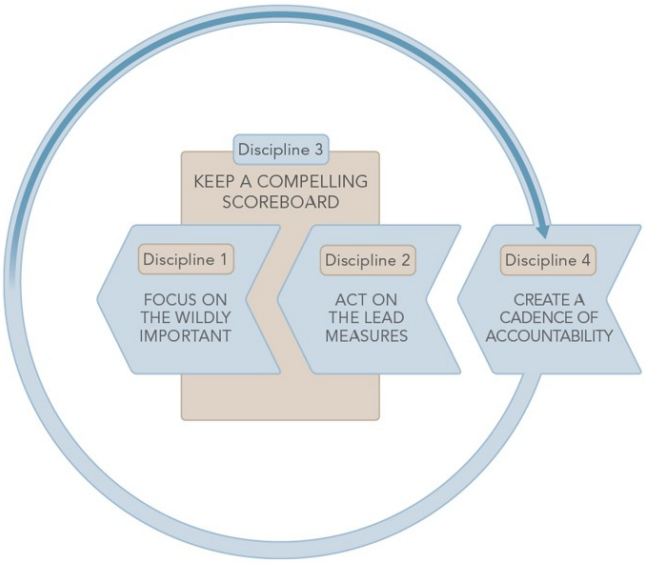


Figure 38. The 4 Disciplines of Execution (4DX) (source: [84])

Why does this occur? First, focusing on "achieving results" is highly valued by everyone—it's hard to argue with achievement! Second, key terms and concepts may be confusing because definitions overlap (see Table 10 on the preceding page). *Population health lean embraces a balanced approach by focusing on lead and lag indicators*. This is an established best practice popularized by Chris McChesney's best selling book *The 4 Disciplines of Execution* (Figure 38) [84]. Discipline 1 is "focus on the wildly important" (7SQ-1), Discipline 2 is "act on lead indicators" (7SQ-2), Discipline 3 is "keep a compelling scoreboard" (7SQ-2: lead and lag indicators), and Discipline 4 is "create a cadence of accountability" (lean tools: validate learning, daily management, visual controls, *kanban* project management, etc.).

Table 12. Comparison of performance improvement approaches

"SIPOC" indicators	RBA	Lean	4DX	PHL
Suppliers		+++		++++
Inputs	+	++++		++++
Processes	++	++++	Lead	++++
Outputs	+++	++++	Lead	++++
Early Outcomes[a]	++++	+++	Lag[b]	++++
Late Outcomes[a]	++++	+	Lag	++++

[a] Primary customer (the "C" in SIPOC)
[b] or lead (e.g., "test of cure" in STD treatments)

Table 12 compares how different improvement approaches focus their methods across the "SIPOC" indicators. RBA focuses on "results" using an epidemiologic framework, but it does not have the process improvement tools of lean. Lean evolved from production systems and is organization-focused with technical jargon (*gemba*, *kaizen*, *genchi genbutsu*, *kanban*, *hansei*, *hoshin kanri*, etc.) and tools. The 4DX provides a business perspective promoting a focus on lead indicators. From an organization and community health perspective, these approaches complement each other nicely—hence, the emergence of population health lean.

In collective impact, the early objectives are to inspire and mobilize cross-sector community partners to tackle a complex social problem. Collaboratives are motivated by pursuing aspirational results with evidence-based strategies and improvement; hence the popularity of RBA. In contrast, the Toyota Production System (and its lean descendants) evolved to eliminate waste and improve production processes *within* organizations (e.g., manufacturing, health care). Lean evolved into comprehensive management and production systems for organizations. Population health lean uses the best of both approaches.

Select lag indicators Improvements in lag indicators (outcomes) answers the question "Is anyone better off?" Therefore, the selection of lag indicators can inspire and mobilize stakeholders whether they are community residents or clinic staff. RBA uses the following criteria for selecting outcome (lag) indicators:

- **Communication** power (inspires, motivates, mobilizes)
- **Proxy** power (causally linked to key or multiple outcomes)
- **Data** power (high quality and availability)

For the details, see the RBA Guide [83] or Friedman's book [13].

Select lead indicators In contrast, lead indicators answer the questions "How much did we do?" and "How well did we do it?" This includes processes (e.g., STD partner notification times), outputs (e.g., partner located, counseled, screened, and treated), and possibly early outcomes (e.g., STD cure rates). We use the following criteria for selecting lead indicators:

- *causally predictive* of outcomes, and
- *under our control*.

If the proposed lead indicator reflects a process and output *not under our control*, then it becomes a proposed lag indicator—an outcome—that we will try to influence by acting on processes and outputs that we do control (our new proposed lead indicator). Again, we act on lead indicators to causally affect and improve lag indicators. Here is the key selection message:

> *We use different selection criteria for lead and lag indicators. Lag indicators must be meaningful health-related outcomes that inspire and mobilize stakeholders. In contrast, lead indicators should be causal and controllable, even if they are "boring" and do not inspire anyone. However, you must engage and empower front-line staff to select and improve lead indicators.*

Data development agenda (DDA) Sometimes indicators need research, development, or investment. If the indicator is important but not available, do not eliminate it: it goes in the data development agenda for further consideration and work by the **DDA Team**, possibly the backbone or outside consultant.

How are we doing? (current state) Using the lead and lag indicators, describe the current state. For the lag (outcome) indicators include the following:

- Time series **baseline** trend curve
- Projection **forecast**

For the lag indicators ask: How are we doing on the most important of these measures? Forecasts are important because they communicate what we expect to happen if the status quo continues. Is the status quo acceptable? Usually it is not. Forecasts have communication power.

[7SQ-3] What are the drivers? (root causes)

This section is analogous to the "causal analysis" section of an A3 problem solving report (see Table 6 on page 25). Between the goal statement (desired future state) and the current state there is a gap. Why does this gap exist, how big is it, and what are the barriers to closing it? (gap analysis) Look at the time trend curve. What forces are pushing the curve up, and what forces are pushing the curve down? (force field analysis) For problems that must be solved, what are the root causes? (root cause analysis) Try asking "why" five times (5 Whys) or drawing a fish-bone (Ishikawa) diagram. Is there a program theory (theory of causation, change, and action) to guide you based on a review of the literature? Here are key questions to consider (program theory):

1. What are the root causes? (theory of causation: causal model of the core problem without interventions: literature, experts, common sense)
2. What is the theory of change? (causal model that includes change theories; e.g., shaping social norms)
3. What in the theory of action? (causal model that includes actions that activate theory of change)

Ask the questions. Important, unanswered causal questions are moved to the data development agenda for causes (next).

Information and Research Agenda about Causes The DDA Team reviews the literature and conducts key interviews of experts, including community residents. The DDA Team develops a causal model of the most important cause-effect processes. A

causal model informs and guides theories of change and action that are necessary to develop strategies. In general, considering using these types of causal maps: driver diagrams [64], causal-loop diagrams[28] that contain feedback loops, or directed acyclic graphs (DAGs)[29] that do not have feedback loops. Start with driver diagrams. Epidemiologists should be using DAGs [67, 68].

[7SQ-4] What partners can help? (partners)

From Friedman: [13]: "Who are the partners who have a role to play in doing better? . . . no one program or agency can do it alone. The work requires contributions from a wide array of partners, public and private, across the community. . . . However, the work of adding partners is never finished. At each pass through the decision process, it is important to consider who is still needed at the table. The action plan should always have a component that addresses the recruitment and engagement of new partners. . . . [I]n practice, you never have everyone at the table. Processes that can't do anything until everyone is at the table typically don't do anything. *Inclusion is a process not an endpoint.*"

[7SQ-5] What other conditions must exist? (assumptions)

This question was developed by systems engineers that recognized that we operate in complex systems where external forces outside of our control may be supporting or opposing our efforts. Unexpected changes in these forces may threaten or derail our efforts. Sometimes we are unaware of these forces because they are hidden from us or we take them for granted. A best practice in risk management planning is to brainstorm and identify key assumptions that, if one or more of them becomes invalid, would threaten the success of a project.

Causal logic provides a simple, disciplined, systems approach to risk and consequence management planning for external risks. Here's how: Review column 3 of the results matrix (Figure 37), and then we can make the following IF-THEN (cause-effect) statements. Collect these assumptions and use them in planning.

IF	inputs	+ valid assumptions 1	THEN	processes	are executed
IF	processes	+ valid assumptions 2	THEN	outputs	are produced
IF	outputs	+ valid assumptions 3	THEN	outcomes	are achieved
IF	outcomes	+ valid assumptions 4	THEN	goals	are achieved

[7SQ-6] What strategies work? (proposed actions)

Friedman defines *strategy* as "a coherent set of actions that has a reasoned change of improving results. Strategies are made up of our best thinking about what works, and include the contribution of many partners. Strategies operate at both the population and performance levels" [13]. By "reasoned chance" he means theory of change (see Figure 21 on page 26).

For prioritizing and selecting strategies Clear Impact recommends the following criteria [83]:

Values "Is the strategy consistent with the values of the community and/or agency?"

Leverage (impact; effectiveness; theory of change) "How strongly will the proposed strategy impact progress as measured by the [indicator] baselines?" The strategy should be evidence-based. Bottom-line: does it work?

Feasibility (effort) "Is the proposed strategy feasible?" "No-cost and low-cost actions will rate higher here."

Specificity (theory of action) " Is the strategy specific enough to be implemented? Is there a time line with deliverables that answers the questions: Who? What? When? Where? How? There should be budget detail for the strategy, including implications for future budgets."

Friedman recommends rating each potential strategy "high" (H), "medium" (M), or "low" (L). This decision process should be inclusive and participatory with key stakeholders. Notice that Leverage (impact) and Feasibility (effort) are the two criteria used for the PICK chart (see below and p. 42).

The Strategies (proposed actions) section should be summarized with a driver diagram (Figure 21 on page 26) that includes theories of change and action. A driver diagram or causal graph ensures rigor in our causal thinking and planning.

For more guidance on team decision making, or designing strategies, see Section 15 on page 42 on improving decision-making.

Information and Research Agenda about Solutions 7SQ-7 focuses on identifying and selecting evidence-based, cost-effective strategies. Sometimes more research is required to identify evidence-based strategies. Sometimes more information gathering is required to guide priority-setting. Consulting subject matter experts, epidemiologists, or decision analysts may be necessary.

[7SQ-7] How do we get there? (action plan)

The A3 action plan consist of two components:

1. Project schedule (what, who, when) (e.g., Gantt chart)
2. Validated learning (PDSA cycles) ("Study and Act")

Additionally, teams can huddle in front of a *kanban* agile project management board [18]. A *kanban* board is a large white board with three or more columns with task sticky notes that flow from left to right. A typical *kanban* board has three headings:

Backlog ("To do")	**Doing**	**Done**
task 3 task 4	task 2	task 1

Rows can be added to stratify by project, staff, or other useful category. ThedaCare created a "Daily Huddle Board" for daily improvement activities that has become very popular and is described in their best-selling book *Beyond Heroes: A Lean Management System for Healthcare* [20]. Here is a depiction of their *kanban* huddle board (columns: backlog, doing, done):

Ideas post ideas	**"Just do its"** easy fixes	**Implemented** sustain improvements!
PICK chart[a] select ideas	**A3 reports** complex projects	**Celebrations!** celebrate staff!

[a] see Figure 46 on page 42

[28] https://en.wikipedia.org/wiki/Causal_loop_diagram
[29] https://en.wikipedia.org/wiki/Directed_acyclic_graph

12. Lean production (Toyota Production System)

Post-World War II, Toyota Motor Co. faced a daunting challenge: how to build cars that can compete with the U.S. automobile industry. They came to the U.S. and studied the mass production of automobiles and quickly realized they could not compete. They needed a new and different approach. Rather than compete on mass production, they would compete on quality, affordability, and variety. From the U.S. they hired **W. Edwards Deming**, professor, statistician, engineer, and quality consultant to guide their transformation (see https://deming.org/).

Deming promoted what he called the **System of Profound Knowledge** that involved developing an understanding of (a) systems (systems thinking), (b) people (human psychology), (c) variation (statistical thinking), and (d) theory of knowledge creation (i.e., PDSA). With humility, Toyota embraced his teachings.

Toyota experimented, learned, innovated, and continuously improved. Not only did they develop a variety of affordable, reliable, high-quality automobiles, they developed an unique production management system that took the world by storm, and attracted academicians to study how they did it. James Womack, et al. published books that summarized the **Toyota Production System** as having five principles for thinking [85, 86] (Figure 39).

"The five-step thought process for guiding the implementation of lean techniques is easy to remember, but not always easy to achieve:[30]

1. Specify value from the standpoint of the end customer by product family.
2. Identify all the steps in the value stream for each product family, eliminating whenever possible those steps that do not create value.
3. Make the value-creating steps occur in tight sequence so the product will flow smoothly toward the customer.
4. As flow is introduced, let customers pull value from the next upstream activity.
5. As value is specified, value streams are identified, wasted steps are removed, and flow and pull are introduced, begin the process again and continue it until a state of perfection is reached in which perfect value is created with no waste."

Figure 39. Lean principles for thinking from James Womack

[30] https://www.lean.org/WhatsLean/Principles.cfm

What is lean? (Lean Enterprise Institute)

"The core idea is to maximize customer value while minimizing waste. Simply, lean means creating more value for customers with fewer resources.

A lean organization understands customer value and focuses its key processes to continuously increase it. The ultimate goal is to provide perfect value to the customer through a perfect value creation process that has zero waste.

To accomplish this, lean thinking changes the focus of management from optimizing separate technologies, assets, and vertical departments to optimizing the flow of products and services through entire value streams that flow horizontally across technologies, assets, and departments to customers."

The Toyota Way, by Jeffrey Liker

Dr. Liker organized Toyota's **14 principles** into four buckets [8]: (a) long-term **philosophy**, (b) the right **process** will produce the right results, (c) add value to the organization by developing your **people**, and (d) continuously solving root **problems** drives organizational learning. Take three minutes to view this video on the Toyota 14 principles: https://youtu.be/42C2JL-SZ64.

(a) **Philosophy**: think long-term

Principle 1: *Base your management decisions on a long-term philosophy, even at the expense of short-term financial goals.*

The lean organization and leadership **philosophy** includes answers to these questions [27]: (a) What is the **purpose** of this organization? (b) What moral, ethical, and logical **reasoning** guides how we make decisions? (c) What **values** do we need to practice to achieve the purpose? (d) How do we define goals and results so they are in **alignment** with our purpose and values?

Hoshin kanri (strategy deployment) are lean methods for ensuring that organization strategic goals drive progress and action at every level [23]. It achieves this by aligning the goals of the organization (strategy) with the plans of middle management (tactics) and the work performed by all employees (operations).

(b) **Process**: the right process will produce the right results

Principle 2: *Create a continuous process flow to bring problems to the surface.*

A *process* is a set of causes and conditions that repeatedly come together in a sequence of steps to transform inputs into outcomes. For example, in manufacturing, the inputs are raw materials, and the outcomes are products that delight a customer; in health care, the inputs are sick patients, and the outcomes are satisfied, well patients; and in the public health lab, inputs are microbiological specimens, and the outcomes are timely results guiding public health action. Processes that create and deliver customer value are called *value streams*. Within a value stream, operational groupings of subprocesses are called *work cycles*.

A value stream crosses operational, functional, programmatic, departmental, or organizational boundaries and is a powerful lean concept that promotes cross-boundary problem-solving, continuous improvement, and process redesign. Any activity or condition that does not add value from the customer perspective is considered waste (*muda*). *Wastefulness is disrespectful to everyone.*

Systematically **identifying and eliminating waste** is a key lean strategy to improve the value stream. Eliminating waste improves process flow, helps to surface problems, saves time and money, and demonstrates respect for customers and staff.

To identify waste use the **TRIM WOOD** acronym:

1. **Transport** (conveyance) of work that is unnecessary.
2. **Resource/Talent** mismatch occurs when human talent or a technical resource capability does not match its intended purpose; for example, a physician doing data entry, using expensive software when a low-cost process works fine, or underutilizing staff knowledge, skills, and capabilities.
3. **Inventory** consumes storage space and staff time.
4. **Motion** or movement of a worker that is unnecessary.
5. **Waiting** represents any waste of time.
6. **Over-processing** is wasteful (e.g., unnecessary sign-offs).
7. **Over-production** is wasteful (e.g., unnecessary services).
8. **Defects** are mistakes or errors that are propagated.

Value stream mapping (VSM) is a powerful lean method for mapping and redesigning a value stream to eliminate waste and improve flow, timeliness, safety, and value. We generally focus on eight types of value streams:[31] (a) customers, (b) workforce, (c) products or services, (d) information, (e) diagnostics or therapeutics, (f) supplies, (g) equipment, and (h) process engineering. For learning VSM focus on people (customer, workforce), products or services, or information (e.g., communications).

For example, Figure 40 depicts a VSM for a patient visit to a provider and pharmacy. Note that value-added (VA) ratio is only 4.6%. This means that only 4.6% of the total time (lead time) is spent on value-added activity. This low percentage is very typical for most processes. You can safely assume that all your current value streams have VA ratios of less than 10 percent.

A value stream mapping workshop includes tools for identifying and measuring the eight wastes. For example, a "spaghetti" diagram displays wasted staff movement.[32] A gemba "waste walk" and "waste wheel" identify and display the wastes. Frontline staff and unaffiliated persons ("fresh eyes") are great for this.

[31] Definitions adapted from Rona Consulting (https://www.ronaconsulting.com/)

[32] For example, see http://asq.org/learn-about-quality/process-analysis-tools/overview/spaghetti-diagram.html

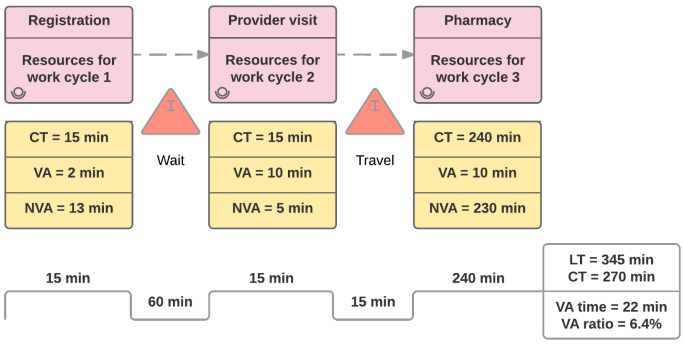


Figure 40. Value stream map of patient visit to provider and pharmacy with work cycle times (CT), lead time (LT), value-added (VA) time, and VA ratio (equals VA total divided by LT).

Principle 3: *Use "pull" systems to avoid overproduction.*

A pull system is a general lean strategy to reduce waste by not producing something until it is requested or needed. This reduces the wastes of overproduction and inventory.

From IHI.org:[33] "In a pull system of service, the timely transition of work from one step in the process to another is the primary responsibility of the downstream (i.e., subsequent) process—for example, the intensive care unit (ICU) orchestrating the transfer of the patient from the emergency department (ED). This is in contrast to most traditional 'push systems,' in which the transition of work is the responsibility of the upstream (i.e., prior) process—for example, the ED trying to 'push' patients into the ICU. Pull systems can be created whenever a patient is being moved from one point of care to the next. . . ."

Kanban boards for project management or huddling are examples of lean pull systems for visual management (see p. 36).

Principle 4: *Level out the workload (heijunka).*

Heijunka is leveling "the type and quantity of production over a fixed period of time. This enables production to efficiently meet customer demands while avoiding batching and results in minimum inventories, capital costs, manpower, and production lead time through the whole value stream."[34]

Heijunka balances the relationship between predictability, flexibility and stability. Heijunka provides predictability by leveling demand, flexibility by decreasing changeover time (increasing agility and responsiveness), and stability by averaging production volume and type over the long term.[35]

Leveling production reduces *mura* (unevenness in productivity and quality), and *muri* (overburden of machines, managers, and staff). *Mura* and *muri* together create muda (waste).

Principle 5: *Build a culture of stopping to fix problems, to get quality right the first time (jidoka).*

Jidoka is designing processes to (a) prevent mistakes ("building quality in," "getting it right the first time every time"), (b) detect mistakes early and fix them, and (c) leverage technology to prevent, detect, and fix mistakes (*autonomation*).[36]

Jidoka highlights the causes of problems because work stops immediately when a problem first occurs. This leads to improvements in the processes that build in quality by eliminating the root causes of defects and the need for re-work (overprocessing).

Jidoka applies to all fields and value streams but especially to population health. Think about it: the human life course, especially early childhood neurodevelopment, is the ultimate value stream. Structural trauma (poverty, racism, discrimination) and toxic stress affects a child's learning, behavior, and health for life. The effects of trauma and toxic stress are transmitted across generations socially and biologically. For us, jidoka also means having a relentless focus on the family- and community-centered, life-course approach where we prioritize social policies to protect our most vulnerable—children ages 0 to 5 years.

[33] From http://www.ihi.org/resources/Pages/Changes/UsePullSystems.aspx

[34] See https://www.lean.org/lexicon/heijunka.

[35] Adapted from https://www.isixsigma.com.

[36] Autonomation means automation with human intelligence.

Principle 6: *Standardized tasks and processes are the foundation for continuous improvement and employee empowerment.*

A *standard* is a rule or example that provides clear expectations [21]. Standards are specific, science-based, and documented. *Standardization* is the practice of setting, communicating, following, and improving standards. For important work, and for every worker, **standard work** *is the agreed-upon, best-known, least wasteful way of doing the work today until a better way is found.*

Adapted from the Lean Enterprise Institute: Standard work is one of the most powerful lean tools. By documenting the current best practice, standard work forms the baseline for continuous improvement (kaizen). As the standard is improved, the new standard becomes the baseline for further improvements, and so on. Improving standard work is a never-ending process.

Standard work consists of five elements [21]: (a) standard task, (b) standard work sequence, (c) *takt* time,[37] (d) standard work in process (SWIP), and (e) documentation. Establishing standard work relies on collecting and recording data on a few forms. These forms are used by frontline staff and managers to design the process and to make improvements in their work.

Principle 7: *Use visual control so no problems are hidden.*

Lean visual management methods promote daily situational awareness, shared understanding, team problem solving, and continuous improvement. Start with **5S** for organizing the workspace for daily visual management [19]. 5S engages staff to set standards and exercise daily discipline.

1. **Sort**: Sort out and separate that which is needed and not needed in the work area.
2. **Set in order**: Arrange items that are needed so that they are ready and easy to use. Clearly identify locations for all items so that anyone can find them and return them once the task is completed. ("A place for everything and everything in its place.")
3. **Shine**: Clean the workplace and equipment on a regular basis in order to maintain standards and identify defects.
4. **Standardize**: Revisit the first three of the 5S on a frequent basis and confirm the condition of the Gemba using standard procedures.
5. **Sustain**: Keep to the rules to maintain the standard and continue to improve every day.

Visual management boards support shared understanding, project management, team problem-solving, and individual and team accountability; for example, (a) visibility boards for hoshin kanri (strategy deployment), (b) *kanban* boards for agile project management, and (c) *kanban* boards for daily huddles.

Principle 8: *Use only reliable, thoroughly tested technology that serves your people and processes.*

Do not deploy technology solutions until you have stable processes that have undergone extensive waste elimination and redesign. Deploying technology systems on top of inefficient business processes amplifies inefficiencies and makes them permanent. Technology and software consultants dream about securing bloated contracts to build solutions for inefficient systems.

[37] Rate at which services must be delivered to meet customer demand.

(c) **People**: respect, challenge, and grow people

Principles 9–11 are central to population health lean and are covered in other sections.

Principle 9: *Grow leaders who thoroughly understand the work, live the philosophy, and teach it to others.*

See "Leadership philosophy" (Section 2 on page 2), "Humility is the new smart" (Section 5 on page 8), "Lean thinking" (Section 10 on page 22), and "Leading population health" (Section 7 on page 13).

Principle 10: *Develop exceptional people and teams who follow your company's philosophy.*

See "Building effective teams"(Section 6 on page 10).

Principle 11: *Respect your extended network of partners and suppliers by challenging them and helping them improve.*

See "Collective impact methods" (Section 11 on page 30).

(d) **Problem-solving** drives organizational learning

Principle 12: *Go and see for yourself to thoroughly understand the situation (genchi genbutsu).*

Genchi genbutsu—going to the *gemba* to see and understand—is a best practice that is very highly developed in design thinking (Section 14 on page 41). The gemba is the site where value is created. In population health, value is created, protected, and promoted in communities, organizations, and centers of power (legislators, mayors, city councils, and health boards).

Principle 13: *Make decisions slowly by consensus, thoroughly considering all options; implement decisions rapidly (nemawashi).*

See "Lean thinking" (Section 10 on page 22), and "Making better decisions with Decision Quality" (Section 15 on page 42).

Principle 14: *Become a learning organization through relentless reflection (hansei) and continuous improvement (kaizen).*

Population health lean builds on lean production, integrating the best practices from complementary frameworks (e.g., PDSA). Figure 1 on page 1 depicts how it all fits together. Moving from left to right, design thinking always applies as human-centered customer development. For developing new products or services in the face of extreme uncertainty, lean startup promotes minimum viable product (MVP) experimentation, adaptation, and innovation ("fail fast, fail cheap, fail forward"). Finally, collective impact transforms community health through collaboration and adaptation, and relentlessly asking "Is anyone better off?"

Lean-based methods specialize in eliminating waste from inputs and processes (see Table 10 on page 33) while results-based methods specialize on mobilizing community partners to tackle a complex social problem with a common agenda with a shared measurement system (e.g., RBA). These methods are complementary and synergistic. Another way to think about this is by examining the "performance efficiency ratio" (PER):

$$PER \approx \frac{\text{outputs} + \text{outcomes}}{\text{inputs} + \text{processes}} \approx \frac{\text{results-based methods}}{\text{lean-based methods}} \approx \frac{RBA}{lean}$$

Our goal in PHL is to *always increase the PER* by increasing the numerator and/or decreasing the denominator.

13. Lean startup accelerates learning and reduces risk

Lean is based on the Toyota Production System and has transformed manufacturing and health care. In 2011, Eric Ries, software engineer turned entrepreneur, published *The Lean Startup*—a bestselling book that described the application of lean concepts to technology startup companies [15]. Not obvious to everyone is that every startup is an experiment! So what is a startup?

> A startup is a *human institution* designed to *create a new product or service* under conditions of *extreme uncertainty*.

"Anyone who is creating a new product or business under conditions of extreme uncertainty is an entrepreneur whether he or she knows it or not and whether working in a government agency, a venture-backed company, a nonprofit, or a decidedly for-profit company with financial investors" [15]. Lean startup is transforming nonprofits and government agencies with the realization that much of what we do is entrepreneurship. Lean startup has catalyzed a mindset shift in the public and social impact sector [56].

Ries studied and experimented applying lean principles to startup companies. He developed these five principles of the lean startup: (a) Entrepreneurs are everywhere; (a) Entrepreneurship is management; (a) Validated learning; (a) Innovation accounting; and (a) Build-Learn-Measure (Figure 41).

Startups have a unique role beyond serving customers: they "exist to *learn* how to build a sustainable business." Lean startups test a hypothesis by quickly (and cheaply) building a minimum viable product (MVP) to test with their customers. MVPs tests needs and solutions. Startups *rapidly* experiment ("fail fast"), learn, and change course when indicated ("pivot or persevere").

Therefore, entrepreneurs (that's us!) must experiment and innovate in these core areas:

1. Customer development (understand needs and problems)
2. Product development (agile discovery, design, and testing)
3. Business model design (discover, sustain, scale, and partner)

In summary, *validated learning* is just "PDSA with a purposeful or strategic goal" where the goal is to innovate successfully in customer, solution, and business model development.

Innovation accounting is a shared measurement system with actionable metrics designed to monitor progress, and to guide decision-making, priority-setting, and accountability. Actionable metrics are lead indicators (see Table 10 on page 33) that are causally linked to the outcome hypothesis (customer, solution, business model). A shared measurement system was first introduced in collective impact methods (e.g., Results-Based Accountability™). Without such a system it is impossible to make data-driven decisions. "Vanity metrics" are lag indicators trending positive but misleading because they are not causally linked to experiments.

Table 5 on page 22 displays how the lean startup Build-Measure-Learn cycle is a PDSA variant, and how it complements design thinking. Lean startup concepts are not new: they are established lean principles successfully applied to the unique circumstance facing startups, and even mission-driven organizations.

Mission Model Canvas (A3-equivalent for lean startup)

Lean startup has been adapted for mission-driven, social change organizations [56]. An alternative to the A3 report is the Mission Model Canvas with nine sections:[38]

1. **Beneficiaries**: Who are the most important people we are serving or creating value for (including funders)? Who is providing us with revenue? What types of people are we serving and interacting with?
2. **Value proposition**: What problems are we helping to solve? What value are we creating for our beneficiaries? What is the solution we are offering? What needs are we satisfying for whom?
3. **Mission Achievement/Impact Factors**: See "Collective impact (results-based) methods" on p. 30.
4. **Deployment**: What are the channels we will use to reach our beneficiaries? How do we reach them now? How many channels are there and how do they work together? Which ones are most effective? How are we integrating them with our beneficiaries' routines?
5. **Buy-in/Support**: What type of relationship does each type of target and partner expect us to establish and maintain with them? Which relationships do we already have, and what role do these relationships play in our theory of change? How much do these relationships cost?
6. **Activities**: What key activities are required for customer, product, and business model development?
7. **Resources**: What key human and material resources do our value propositions and model canvas components require?
8. **Partners**: Who are the key partners or suppliers? What activities do they perform? Which resources do they provide?
9. **Costs/Budgets** (including revenue streams): What are the most important costs inherent in our operating model? Which key resources are most expensive? Which key activities are most expensive? How will this work be funded? What will each potential funder be willing to pay for / contribute to? How are they currently paying / contributing?

[38] See Mission Model Canvas here: http://bit.ly/mm-canvas, article here: http://bit.ly/hp-mmcanvas, and webinar here: https://youtu.be/_jvwCY1OjlQ

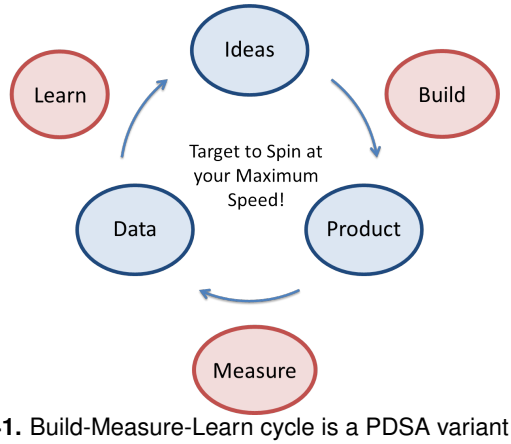


Figure 41. Build-Measure-Learn cycle is a PDSA variant that promotes experimentation, validated learning, and innovation.

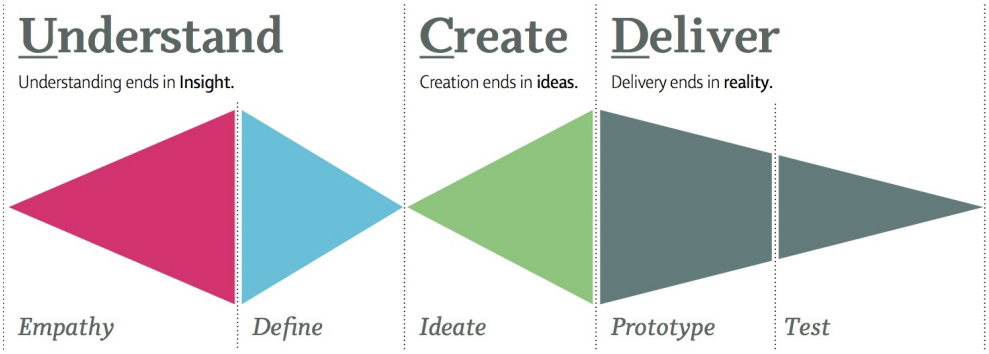


Figure 42. Design thinking as depicted by Empathy design consultants (http://designthinking.co.nz/design-thinking-in-a-day/)

14. Design thinking (human-centered design)

Because of its importance, design thinking (Figure 42) was introduced in Table 5 on page 22. Design thinking is a creative, need and problem-finding process for designing products, services, or environments that delight humans and fulfill their needs. Recall from Figure 16 on page 22 this relationship: Theory + Practice → Results. Traditional PDSA focuses on improving practice (knowledge deployment) or improving theory (knowledge discovery) in existing operational processes. Performance improvements come from process innovations that improve results (Figure 43).

However, we can do better: "What results (value) do our customers care about that we could deliver?" Humans value experiences that are emotionally fulfilling *and* solve their problems. Using design thinking (Figure 42) *we can discover, prototype, and test new solutions that are process, functional, and emotional innovations* (i.e., human experience innovations in Figure 43).

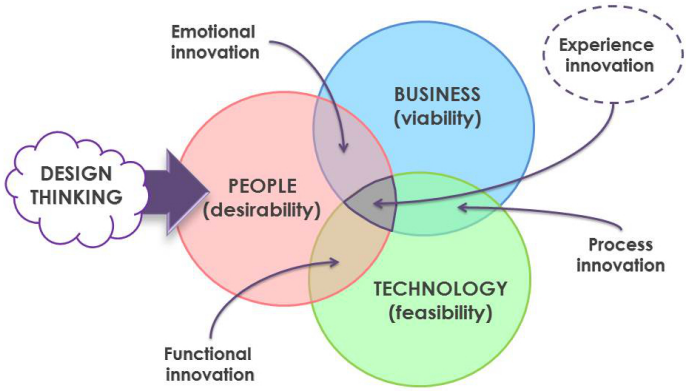


Figure 43. Design thinking: innovations in human experiences

Design thinking is a creative, systematic framework that is especially valuable for discovering new solutions where best practices are scarce, customer engagement and behavioral change is essential, or data and analytic methods are not available.

Design thinking has five phases that are either in a creative, divergent phase, or in a focused, convergent phase. Designers cycle back to whatever step improves insight and learning. Design thinking should become a natural part of population health lean thinking (PDSA, validated learning, and A3 reports).

Design thinkers have the following mindset: human centeredness, bias towards action, show don't tell, radical collaboration, culture of prototyping, and mindfulness of process. In the Toyota Production System genchi genbutsu meant going to where workers created value (i.e., on the shop floor). However, in population health lean we embrace human-centered design and prioritize going to where population health is created, protected, and promoted—in the community using a neighborhood, family-centered, life course lens! Here are the five phases:

[1] Empathy: Seek understanding and insight by observing and interviewing primary customers (preferably) in their natural social and community context. This usually involves ethnographic methods, including recognizing and setting aside our own cultural and cognitive biases. The objective is to understand what matters most to them? What are their unfulfilled needs? Beyond what they say and do, how do they *think* and *feel*?

[2] Define: Empathy leads to creating a "point of view" (problem definition and/or new opportunity identification) that is based on customer needs and insights, defining the current condition, and setting a vision and goals.

[3] Ideate: Ideation is structured brainstorming to generate and select creative solution ideas. Good brainstorming requires open-mindedness and embracing a few rules that promote creativity: (a) framing the problem, (b) warming up, (c) brainstorming, and (d) grouping and selecting ideas. Here are the rules: (a) Defer judgment. (b) Go for volume (many!). (c) One conversation at a time. (d) Be visual. (e) Headline your idea. (f) Build on the ideas of others. (g) Stay on topic. (h) Encourage wild ideas.

[4] Prototype: Prototype means building quickly a low resolution representation of one or more ideas to show others. The purpose is to test customers' and our understanding of needs and solution ideas, and not necessarily to test specific solutions.

[5] Test: Begin to test the product or service with customers. Prototyping and testing are similar to PDSA cycles in their embrace of experimentation with the intention of learning and improving.

Design thinking has spread beyond technology innovations, and is now used for strategy innovations. There are many resources for learning design thinking [16, 87–90]. Start by doing and experimenting with free materials from Stanford.[39]

[39] http://dschool.stanford.edu/

15. Improving strategic decision-making

The roads we take are more important than the goals we announce. Decisions determine destiny.
. . . Frederick Speakman

Influenced by sensory input and *intuition* (feelings and emotions) [1,2], humans use *reasoning*, *deciding*, *acting*, and *learning* which are innate to all human activities, and form the basis for continuous improvement. *Adaptation* comes from adjusting our decisions and actions based on what we learn. *Improvements* are adaptations that make things better.

Learning organizations promote high quality (a) decision–making, (b) strategic execution, (c) performance improvement, and (d) positive and safe environments (psychological safety).

Front and center is the **art and science of decision-making**. Yet most of us have not received *any* training in decision-making. This is probably because we have been making acceptable decisions all of our lives. Naturally, we conclude that "successful" people, by definition, must be "good" decision makers. And some are; however, research shows that we have a lot of room for improvement—so why not get better! Fortunately, the decision sciences has progressed significantly and we have practical tools for improving individual and team decision making.

What is a decision? *"A decision is a choice between two or more alternatives that involves an irrevocable allocation of resources"* [73]. For important, high stakes, or high costs issues, *do not* rely on gut decisions—deliberate! Here's why: decision challenges include: (a) uncertainty; (b) competing objectives; (c) values and preferences; (d) time and resource constraints; (e) multiple decision parties; and (f) organizational, environmental, and analytical complexity (Figure 44).

Organizational complexity means requiring the people facilitation skills (e.g., emotional intelligence) to deal with a diversity of stakeholders who may not agree or trust each other. High analytical complexity means requiring quantitative methods.

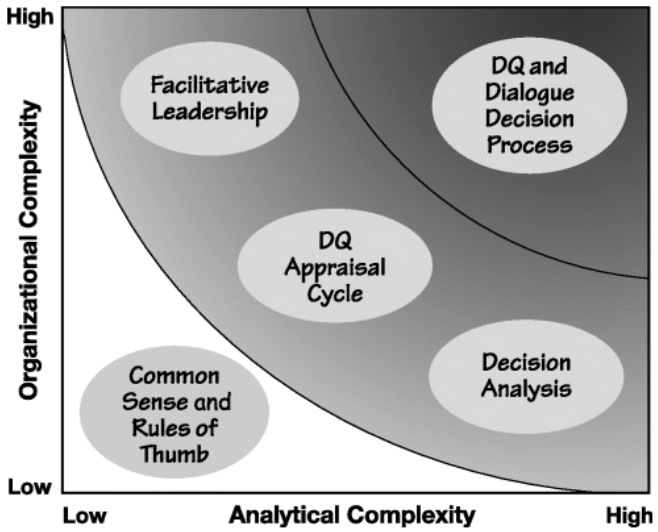


Figure 44. Decision approaches for different levels of organizational and analytical complexity [17]

Figure 45. Fist to Five voting for building consensus

Facilitative leadership

Consensus using Fist to Five voting

Consensus means building, through discussion, acceptable *shared understanding* and *commitment to action*. When building team consensus is important try **Fist to Five** voting (Figure 45). Each person votes by holding up 0 to 5 fingers, where 0 is a fist: **0:** "No way, terrible choice, I will not go along with it" (fist blocks consensus); **1:** "I have serious reservations with this idea, but I vote to move forward, but I'd prefer to resolve the concerns before supporting it." **2:** "I have some concerns, but I'll go along and try it." **3:** "I will support the idea." **4:** "I like this idea, sounds good." **5:** "Absolutely, best idea ever! I'll champion it." Continue discussion until everyone is voting 3 or above.

PICK chart to "pick" improvement projects

In daily huddles teams use the **PICK chart** (Figure 46) to prioritize and select improvement ideas. The PICK chart introduces teams to deliberative, multi-criteria decision-making. Ideas with higher effect-to-effort ratios are moved closer to the top-left corner. For an excellent discussion read Mark Graban's blog here: http://www.leanblog.org/2014/07/picking-on-the-pick-chart/.

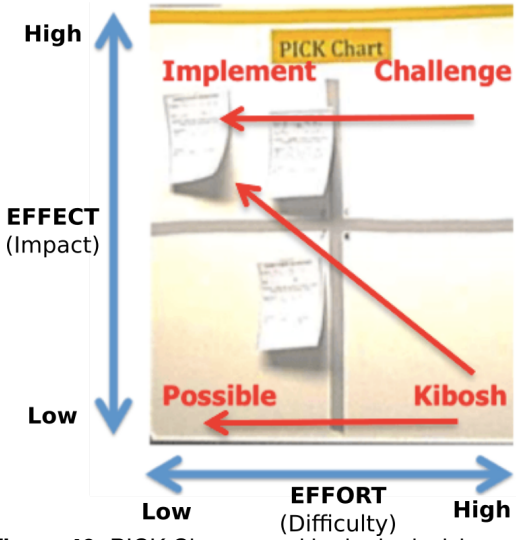


Figure 46. PICK Chart: a multi-criteria decision tool

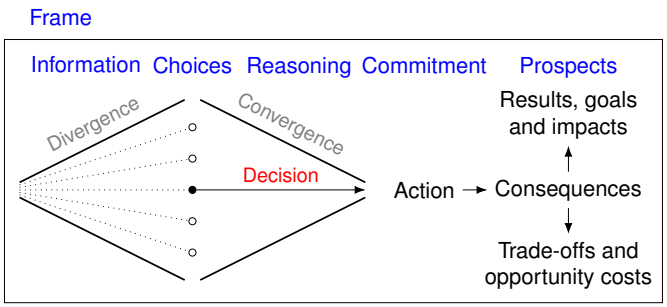


Figure 47. Decision Quality has six requirements: frame, information (data, evidence), choices (creative options), reasoning (analysis), commitment (people) and prospects (future state)

Decision quality (DQ) appraisal cycle

For important decisions, we must ensure **decision quality** (DQ) (Figure 47). A good decision requires quality at each link, and the overall quality of a decision is no better than the weakest link [17]. As before, use A3 paper for DQ appraisal cycle (Table 14).

Starting with the appropriate frame, ask the following:

1. What are we deciding and why? (frame)
2. What choices do we have? (choices)
3. What do we need to know? (information)
4. What future states do we care about? (prospects)
5. Are we thinking straight? (reasoning)
6. Is there commitment to action? (group consensus)

DQ-1. Frame (What are we deciding and why?)

1. *Purpose*: What problem are we trying to solve? What opportunity are we addressing? Why are we doing it? What do we intend to achieve? Why now? How will we know if we're successful? How could we fail?
2. *Perspective*: Who are the primary customers? What other perspectives will help? (see Table 13); and
3. *Scope*: What decisions are "Taken as Given," "Focus On," and "Decide Later" (called **Decision Hierarchy**). The "Focus On" questions become columns in the Strategy Table (Figure 48).

Public health decisions involve multiple considerations and stakeholders. Use the **(HELP)^2 Checklist** (Table 13) to design and improve decision making processes (source: TJA):

Table 13. The (HELP)^2 Checklist for improving decision quality

Health benefits (outcomes)	**H**ealth equity
Ethical issues (see p. 46)	**E**fficiency issues[a]
Legal exposures	**L**ogistical issues
Public trust	**P**olitical support

[a] For example, cost-effective analysis ratios: maximize health outcomes in the numerator and minimize costs in the denominator by eliminating waste using lean.

DQ-2. Choices (What choices do we have?)

1. What are the choices (or strategies) under consideration?
2. Are the choices consistent with organizational strategy?
3. Do the choices fit the frame?
4. Are the choices well-defined? creative? doable? compelling? comprehensive range? significantly different?

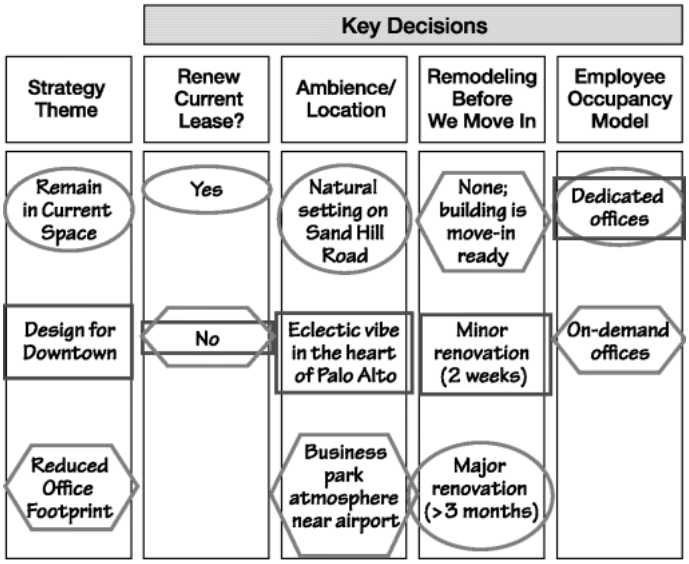


Figure 48. Strategy Table example based on an office move decision [17]

One creative approach is to build a **Strategy Table** (Figure 48) from the "Focus On" key decisions from the Decision Hierarchy. Use these decisions as column headings. Under each key decision column have a set of choices that are reasonably comprehensive and mutually exclusive. Design strategy themes by selecting a set of choices (not more than one per column). The strategies should range from the least aggressive to the most aggressive strategy.

Table 14. A3-DQ: Decision quality on A3 paper

Decision quality	Activity (Table 5)
Plan	
1. Frame (purpose, perspective, and scope)	Define
2. Prospects (possible future states; goals)	⇓
3. Information (relevant, reliable data)	⇓
4. Reasoning (synthesis and analysis)	Design
5. Choices (creative, doable alternatives)	Decide
6. Commitment to action	⇓
Do	⇓
7. Action plan	Experiment[a]
Study and Act	Learn[b]
8. Validated learning (PDSA cycles)	Improve[c]

[a] Prediction, Experimentation, and Measurement

[b] Mindful observation, Reasoning, and Reflection

[c] Adoption, adaptation, or abandonment ("pivot or persevere")

DQ-3. Information (What do we need to know?)

1. Do we have the information needed to make the decision?
2. What are the major uncertainties? Have we quantified the uncertainties with ranges and probabilities?
3. What are the most critical factors that drive value and risk?
4. Does information reflect the judgment of experts we trust?
5. Are we focusing on getting the right additional information

(i.e., where the benefits outweigh the costs)?
6. How are we accounting for intangibles?

DQ-4. Prospects (What future states do we care about?)

1. What future states will be created from our choices, actions, and consequences?
2. How are the evaluation criteria and the trade-offs?
3. Who are the stakeholders, what do they expect, and what is the anticipated impact of our choices on them?
4. Are the choices congruent with the values of the organization?
5. If the consequences of choices could seriously harm the organization, has leadership risk attitude been considered?
6. Are the values and trade-offs clearly stated, well understood, and easy to communicate?

DQ-5. Reasoning

1. Are we thinking straight about this?
2. How does our evaluation model work?
3. For each choice, what are the key sources of value?
4. For each choice, what are the primary drivers of risk?
5. How do the choices compare?
6. Is the reasoning easy to understand and communicate?

DQ-6. Commitment to action

1. Do we have a consensus to take action?
2. Are we willing to commit the resources?
3. Is the best choice clear? What/who could change our minds?
4. Does our choice have broad support with the organization?
5. Do the people implementing the action have the authority, ability, resources, motivation, and discipline required?
6. What is the plan for implementation and communication?
7. Is the rest of the organization aware that this decision is coming? How are we going to communicate it?

Decision analysis

Decision analysis (DA) is the applied discipline "that addresses the complexities of making decisions in the face of uncertainty, dynamics (multiple rounds of deciding and learning), and multiple factors that affect value [17]." The field was pioneered by Ronald A. Howard at Stanford University [73], and has been very influential in the fields of health and medical decision making [71, 72]. DA tackles uncertainty head-on using probability theory, especially Bayes Theorem. DA methods include decision trees, Monte Carlo simulations, Markov modeling, relevance diagrams (also called influence diagrams or value maps), Bayesian networks, etc. DA is beyond the scope of this handout.

Dialog Decision Process (DDP)

When decisions have high stakes, high costs, and high uncertainty (i.e., high organizational and analytical complexity) we need a rigorous deliberative process involving a decision board *and* a project team. The **decision board** is the individual or board charged with making a final decision (or recommending a final decision) that achieves DQ. The decision board is trained in and has responsibility for ensuring DQ. The **project team** includes individuals who (a) are trusted by board members to execute their roles in the DDP, (b) are important stakeholders in the decision and its eventual implementation, and (c) are competent in decision-making methods.

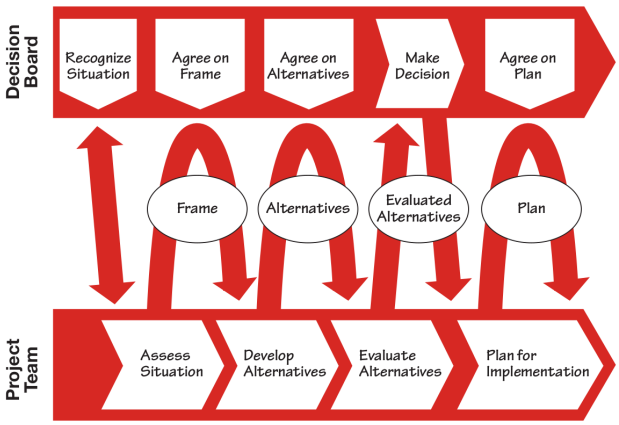


Figure 49. Dialog Decision Process (source: http://sdg.com)

The **Dialogue Decision Process** (Figure 49) has four-stages:

1. **define** frame and prospects (futures states we care about),
2. **design** creative choices using reliable, relevant information,
3. **decide** among choices using sound reasoning, and
4. **do** action plan with committed stakeholders.

that guides decision makers to execute high quality decisions through dialogue with a project team, creating alignment and commitment to the highest value choice along the way. The DDP is designed to avoid cognitive biases and to satisfy the requirements for DQ.

"The project team's job is to assess the situation, propose a frame, develop alternatives, build a decision model, gather necessary information, apply sound reasoning to evaluate the alternative, present clear comparisons of the alternative, and recommend a course of action to the decision board, whose job it is to make the decision" [17].

Here are the **Decision Maker's Bill of Rights** [17]: Every decision maker has the right to decision quality, achieved through:

1. A decision *frame* that structures the decision in the most relevant context.
2. Creative *choices* that enable a selection among viable and distinct choices.
3. Relevant and reliable *information* upon which to base a decision, incorporating the inherent uncertainty.
4. An understanding of *prospects* as the potential future states created by our values, choices, actions and consequences..
5. Sound *reasoning* and analysis that allow decision makers to draw meaningful conclusions and choose the best choice.
6. An effective decision project leader who can achieve consensus; i.e., *alignment* and *commitment* to the best action.

Priority-setting and resource allocation (PSRA)

A universal challenge faced by many organizations with fixed budgets[40] is "How do we set budget priorities in the face of cutbacks?" Today, budget decision-makers follow these common

[40] For example, government agencies, managed-care health systems, community-based organizations

practices [91]: (a) historical patterns ("last year's budget," organizational culture or tradition), (b) politics and power (authority, reaction, interests, expertise) (c) advocacy ("squeaky wheel gets the oil"), (d) needs assessments, (e) core services (e.g., legally mandated activities), or (f) equality ("every program cuts *x*%.").

We can do better! The general approach is called *priority-setting and resource allocation* (PSRA). There is tremendous global experience in addressing the challenge of constrained or shrinking budgets in real world health systems settings [92, 93]. Building upon decision quality concepts, the most common PSRA framework includes:

1. Program budgeting and marginal analysis (PBMA),
2. Multi-criteria decision analysis (MCDA), and
3. Accountability for reasonableness (A4R).

Program budgeting and marginal analysis

PBMA leverages three key economic concepts: opportunity cost, margin, and efficiency. Every time we choose to use resources (money, time) to meet one need (say, Option A) we automatically give up the "opportunity" to use those resources to meet some other need (say, Option B). The loss benefit by not choosing Option B is the *opportunity cost*. In contrast to cost accounting approaches, the aim of economics is to ensure that we undertake activities where *benefits outweigh opportunity cost* [94].

In practice, we actually make changes incrementally or at the "margin": while not changing most of our programmatic activities, we add a few activities and we discontinue a few activities. The *marginal cost* is the cost of one more unit of output or consumption, and the *marginal benefit* is the benefit from one more unit of output or consumption. The marginal efficiency is the marginal benefit divided by the marginal cost.

When we focus on programs, we have two types of efficiencies: technical (operational) efficiency and allocative efficiency. *Technical efficiency* is when we improve marginal efficiency *within* a program. Examples include (a) deploying a cost-effectiveness intervention, (b) improving performance at the same cost, or (c) eliminating waste using population health lean. The resources released are now available for reallocation.

Allocative efficiency is when we reallocate these resources *across* programs to improve organizational performance. Sometimes this includes discontinuing programs and adding new ones. Discontinuing and adding programs is a type of *marginal efficiency* at the organizational level.

Program budgeting and marginal analysis (PBMA) focuses on both technical *and* allocative marginal efficiencies. PBMA provides health organizations a structured, deliberative process for setting programmatic and budget priorities under resource constraints, or worse, when budgets must be cut. Without a transparent, fair process for cutting budgets, organizations resort to historical practices based on power, politics, and advocacy.

For health organizations, PBMA has seven steps [94]:

1. Determine the **aim and scope** of the priority setting exercise: Decide whether PBMA will be used to examine changes in services within a single Department or program or between Departments/programs.
2. Compile a **program budget**: Current resources assigned to each defined program should be identified and quantified.
3. Form a marginal analysis **advisory panel**: Key stakeholders (managers, clinicians, consumers, etc.) should be able to contribute to the priority setting process through this formal Advisory Panel, or in some other clearly defined manner.
4. Determine locally relevant **decision-making criteria**: All proposed investments or disinvestments will be assessed against these criteria, which should reflect the mission and mandate of the organization and the values of the community which it serves.
5. Identify **options for service growth and resource release**: (a) Service growth, (b) Resource release from gains in operational efficiency, (c) Resource release from scaling back or ceasing some services: These proposals can be developed by an organization's senior leaders or solicited from staff through an engagement process.
6. Evaluate **investments** *and* **disinvestments**: Using the agreed-upon criteria, managers will consider options and make recommendations for moving resources from 5 (b) and 5 (c) to 5 (a) above.
7. Validate **results** and **reallocate resources**: The leadership group, with additional outside input as desired, will assess the allocation decisions reached through the process and make reasoned adjustments, if necessary.

Multi-criteria decision analysis

PBMA steps 3–6 use multi-criteria decision analysis (MCDA) for deliberative, structured decision making by the Advisory Panel. The Advisory Panel consists of technical and community stakeholders and differs from the Decision Board that makes final decisions. MCDA is also called multi-objective decision-making (MODM) because we want to optimize multiple objectives that have completing trade-offs. Businesses use decision analysis to optimize one objective—profits! In contrast, health organizations get a fixed budget (general fund, grant, or managed-care capitation fees) to optimize multiple, competing objectives (improve health, eliminate wastes, etc.).

To structure a MCDA we use an *influence diagram*[41] that has four node types: decision, uncertainty (chance), calculation, and value (Figure 50). Values are the ultimate and measurable *fundamental objectives* we aim to achieve. For clarity and simplification we will not be using uncertainty nodes. For sub-objectives (i.e., "multiple criteria") we will use calculation nodes.

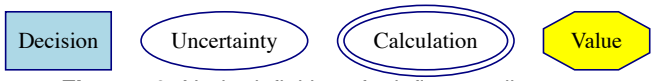


Figure 50. Node definitions for influence diagrams

In the Population Health Division the fundamental objectives have been assigned importance weights by leadership:

1. health impact (HI) (0.50 weight),
2. strategic alignment (SA) (0.30 weight),

[41] Influence diagrams are also called relevance diagrams or Bayesian decision networks; they are the generalization of directed acyclic graphs (DAGs) (p. 26).

Table 15. MDCA: fundamental objectives and multi-criteria

Fundamental objectives	Criteria (sub-objectives; weights not shown)
Health Impact (0.50)	Effectiveness
	Equity
	Primary prevention (social determinants)
	Innovation
	Alignment with community/client preferences
Strategic Alignment (0.30)	Alignment with PHD stated goals
	Alignment with external entities (politicians)
	Ability to meet accreditation (includes PHL)
	Impact on legal or regulatory mandate
	Collaboration/ partnership
	Alignment with PHD goals
Organizational Impact (0.20)	Workforce: morale, professional development
	Operational efficiency
	Sustainability
Financial Impact	Associated Revenue
	Downstream impact on service utilization

3. organizational impact (OI) (0.20 weight), and
4. financial impact (FI) (handled separately).

Each fundamental objective has sub-objectives (or multiple criteria) which are weighted separately (Table 15). Figure 51 depicts the influence diagram for this MCDA. The Advisory Panel uses the criteria to score program proposals using a deliberate, fair, and transparent process (see A4R next section). This results in much improved prior-setting and resource allocation [95–99].

Accountability for reasonableness (A4R)

Accountability for reasonableness (A4R) "serves as an important moral guide for decision makers in ensuring that their priority setting process is fair and legitimate" [96]. A4R fulfills five criteria: (a) *relevance*: decisions based on reasons fair-minded people can agree are relevant under the circumstances; (b) *publicity*: reasons publicly accessible; (c) *revision*: opportunities to revisit/revise decisions and mechanism to resolve disputes; (d) *empowerment*: power differences minimized and effective participation optimized; and (e) *enforcement*: mechanisms to ensure above four conditions met [100].

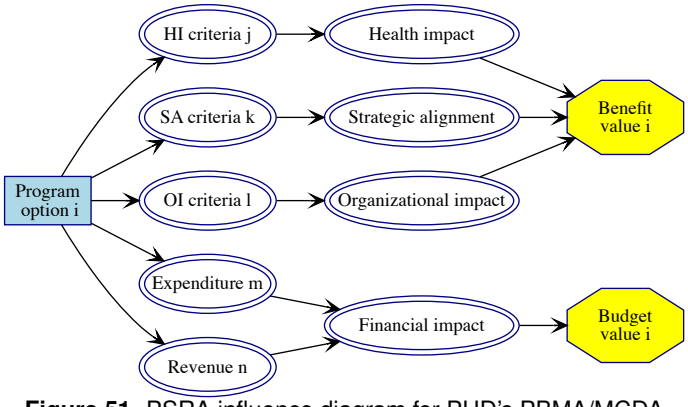


Figure 51. PSRA influence diagram for PHD's PBMA/MCDA

Public health ethics

In public health we incorporate ethics into our decision making. We start with key definitions. "*Public health* is what we, as a society, do collectively to assure the conditions in which people can be healthy" [32]. *Morality* refers to social institution or practice—what people believe, value, and do [101]. *Ethics* is the reflective task of interpreting, understanding, and criticizing morality. In public health ethics we evaluate and weigh how public health actions promote or infringe on **moral considerations (norms)**:

Moral considerations (norms)

1. Producing *benefits*
2. Avoiding, preventing, and removing *harms*
3. Producing the maximal balance of benefits over harms and other costs (often called *utility*)
4. Distributing benefits and burdens fairly (*distributive justice*) and ensuring public participation, including the participation of affected parties (*procedural justice*)
5. Respecting *autonomy*, including liberty of action
6. Protecting *privacy* and *confidentiality*
7. Keeping *promises* and *commitments*
8. Disclosing information as well as speaking honestly and truthfully (often grouped under *transparency*)
9. Building and maintaining *trust*

Justificatory conditions

How do we justify infringing on moral norms such as liberty, privacy, and confidentiality in the selection of public health interventions? To be ethical, we use the following criteria to design and select public health actions:

1. *Effectiveness*: Is the action likely to accomplish the public health goal?
2. *Necessity*: Is the action necessary to override the conflicting ethical claims to achieve the public health goal?
3. *Least infringement*: Is the action the least restrictive and least intrusive?
4. *Proportionality*: Will the probable benefits of the action outweigh the infringed moral norms and any negative effects?
5. *Impartiality*: Are all potentially affected stakeholders treated impartially?
6. *Public justification*: Can public health officials offer public justification that citizens, and in particular those most affected, could find acceptable in principle?

Intervention Ladder

Interventions are listed from least to most intrusive [101]:

1. Do nothing
2. Monitor (e.g., surveillance)
3. Provide information (e.g., health education)
4. Enable choice
5. Guide choice by changing the default policy
6. Guide choice by incentives
7. Guide choice by disincentives
8. Restrict choice
9. Eliminate choice

16. Population health data science

Population health data science (PHDS) *is the art and science of transforming data into information and actionable knowledge*

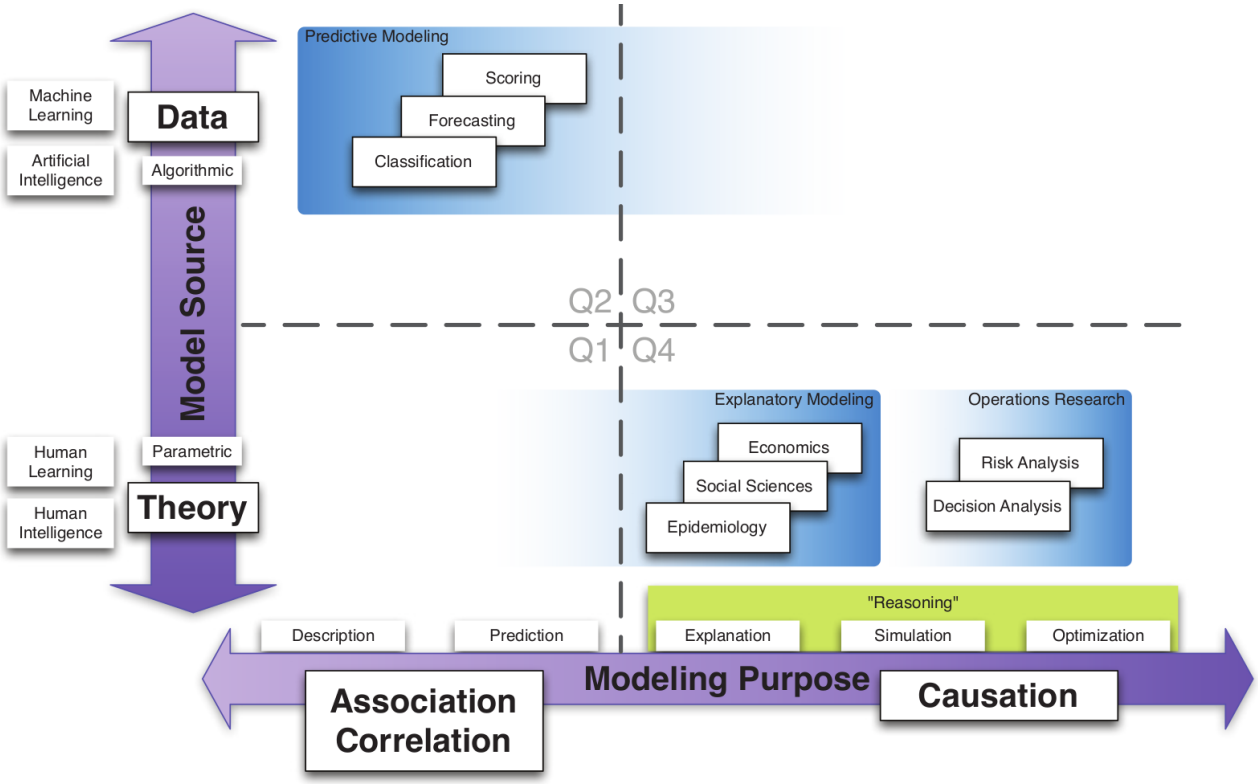


Figure 52. Population health data science landscape (source: http://www.bayesia.com/)

that informs, influences or optimizes decisions and actions that protect and improve health and well-being.

PHDS is categorized into five analytic domains (see Figure 52): (1) *description*: measuring the burden of risk factors and outcomes; (2) *prediction*: early targeting of prevention and response strategies; (3) *explanation*: testing causal pathways for designing prevention strategies, and discovering and testing new causal pathways; (4) *simulation*: modeling processes for epidemiologic and decision insights; and (5) *optimization*: optimizing decision-making, priority-setting, and resource allocation. Discovery, simulation, and optimization support causal and evidential reasoning that guide decisions, design, deployment, learning, and continuous improvement.

PHDS is a rapidly growing field that emerged from solving public health problems. In public health practice, we need to influence, guide, and advise decision makers in a relevant and timely way. Decision makers include patients, providers, policy makers, colleagues, and community stakeholders. When possible, timeliness should be in real time. Peer-reviewed scientific publications are often ineffective and too slow. The bottom line challenge is this: the transformation of data into actionable knowledge means improving decision-making in the setting of complex environments, uncertainty, limited information, multiple objectives, competing trade-offs, and time constraints.

PHDS integrates the expertise from public health, epidemiology, medicine, statistics, computer science, decision sciences, health and behavioral economics, and human-centered design. PHDS is the future of public health data analysis and synthesis, and knowledge integration. *Knowledge integration* is the management, synthesis, and translation of knowledge into decision support systems to improve policy, practice, and—ultimately—population health.

Figure 52 summarizes the data science landscape. The general idea is to design *human-centered decision support systems and practices to improve and optimize decision-making from community residents to policy makers*. Examples of PHDS approaches familiar to public health include: (a) health impact assessment, (b) decision analysis, (c) cost-effectiveness analysis, and (d) cost-benefit analysis. Less familiar to public health include the following: (a) operations research, (b) Bayesian networks, (c) machine learning, and (d) artificial intelligence.

"Big data" are the availability of huge data systems with multidimensional, longitudinal data on individuals and their environments that enable us (through computer algorithms) to describe, predict, explain, and optimize the human experience—primarily by influencing human choices (decisions), by targeting public health interventions, and by conducting causal research.

Biostatistics and epidemiology, the quantitative sciences of public health, are essential components of PHDS. Epidemiologists deploy causal inference, risk assessments, and decision analysis [67, 68, 73]; and join data science teams. Biostatisticians contribute through statistical learning methods and research.

Glossary

3P is the production preparation process. Creative process for designing new products, services, systems, or environments.

See also human-centered design.

5S is for organizing a workplace for visual management: sort, set in order, shine, standardize (standard work), and sustain.

actionable metrics In lean startup, actionable metrics are lead indicators (see Table 10 on page 33) that are causally linked to the outcome hypothesis (customer, product, growth), and are used in innovation accounting.

catch-ball is practiced by anyone initiating an improvement project: that person articulates the purpose, objectives, and other ideas and concerns and then "throws" them to the other stakeholders for feedback, support, shared decision making, consensus, and action.

consensus means the discussion group has achieved a sufficient level of *shared understanding* and *commitment to action* to move forward.

Deming, W. Edwards was a quality improvement scholar who developed the System of Profound Knowledge: appreciation for a system (systems thinking), knowledge of variation (statistical thinking), theory of knowledge (learning and adaptation), and psychology (understanding people). For details see https://deming.org/.

data science is the art and science of transforming data into actionable knowledge.

design thinking See "human-centered design."

directed acyclic graph (DAG) is a causal graph with nodes and edges (arrows). For example, $X \to Y$, means that values of Y are caused, at least in part, by X.

discernment "is our ability to hold multiple perspectives without compromising the universal values we stand for. We are able to transcend our usual reactivity and impulsiveness and interpret what is going on without prejudice or bias. We make decisions without being judgmental, anchored in universal values, willing to alter our point of view in the interest of humanity as a whole" [5]

evaluation, developmental is an approach to understanding the activities of a program operating in dynamic, novel environments with complex interactions. It focuses on innovation and strategic learning rather than standard outcomes and is as much a way of thinking about programs-in-context and the feedback they produce.

evaluation, formative is an evaluation that takes place before or during a project's implementation with the aim of improving the project's design and performance. The evaluation complements summative evaluation and is essential for understanding why a program works or doesn't, and what other factors (internal and external) are at work during a project's life.

ego is best understood as "self-concept" which is a collection of beliefs about oneself, including our many identities (gender, racial, professional, etc.) [102]. "Self-concept is made up of one's self-schemas, and interacts with self-esteem, self-knowledge, and the social self to form the self as whole. … The temporal self-appraisal theory argues that people have a tendency to maintain a positive self-evaluation by distancing themselves from their negative self and paying more attention to their positive one" [102].

emotion "is any conscious experience characterized by intense mental activity and a high degree of pleasure or displeasure."[42] There are 27 emotions:[43] admiration, adoration, aesthetic appreciation, amusement, anger, anxiety, awe, awkwardness, boredom, calmness, confusion, craving, disgust, empathic pain, entrancement, excitement, fear, horror, interest, joy, nostalgia, relief, romance, sadness, satisfaction, sexual desire, and surprise.

emotional intelligence (EI) is the "the ability to monitor one's own and others' feelings and emotions, to discriminate among them and to use this information to guide one's thinking and actions" [35]. The EI model includes the abilities to perceive, use, understand, and manage emotions of self and with others. EI has been subsumed by an integrated model called *personal intelligence* [55].

evaluation, summative looks at the impact of an intervention on the target group. It can take place during the project implementation, but is most often undertaken at the end of a project.

five whys In lean startup, "The Five Whys" was adapted from lean production and used for problem solving and root cause analysis.

gemba is a Japanese word that means the place where value is created (workplace or community).

genchi genbutsu is a Japanese expression that means to go and see to understand and empathize. The location is usually the *gemba*.

goal is a specific end result desired or expected to occur as a consequence, at least in part, of an intervention or activity.

growth mindset is embracing the fact that talents can developed through hard work and continuous improvement. A *fixed mindset* believes that talents are innate gifts and cannot be developed [7].

hansei is Japanese for self-reflection and is a central idea in Japanese culture, meaning to acknowledge one's own mistake and to pledge improvement.

hoshin kanri (also called policy deployment) is a management system for ensuring that organization strategic goals drive progress and action at every level. Hoshin kanri aligns organizational goals (strategy) with middle management plans (tactics) and the work performed by all staff (operations).

human-centered design (design thinking) is the creative design of products, services, or environments to delight, fulfill needs, and exceed the expectations of end-users.

humility is "the noble choice to forgo your status, [and to] use your influence for the good of others before yourself" [6] and is "a mindset about oneself that is open-minded, self-accurate, and 'not all about me,' and that enables one to embrace the world as it 'is' in the pursuit of human excellence" [35].

hyperlearning "is learning that's agile, rapid, energizing, engaged, determined, continual, and eager. For humans, that

[42] https://en.wikipedia.org/wiki/Emotion
[43] http://www.pnas.org/cgi/doi/10.1073/pnas.1702247114

learning is both cognitive and emotional. ... [A hyper-learner addresses] the emotionally challenging parts of effective learning—the emotional parts of critical thinking, creativity, innovation, collaborating, and engaging with others" [35].

impact is an estimate of effectiveness. What outcomes can be attributed to a program, agency, service system, or collective impact? For example, "number of deaths averted."

improvement kata see "validated learning."

influence diagram is also called a relevance diagram, Bayesian decision network, or just decision network. Influence diagrams are used to structure complicated decisions, including multi-objective and multi-criteria problems. The node types are decision, uncertainty (chance), calculation (deterministic), and value.

innovation accounting In lean startup, innovation accounting is a visual measurement system with actionable metrics designed to monitor progress, and to guide decision-making, priority-setting, and accountability.

kaizen is a Japanese word that means continuous improvement.

kanban is a Japanese term for "sign" or "signboard." In lean production kanban is a signaling "card" that requests the production or withdrawal of items in a pull system. In contrast, *kanban* boards are used for agile project management and for daily huddle boards.

leader standard work is standard work (including a schedule) for a manager's regular activities to develop people (starting with self) to solve problems and improve performance.

lean startup is a methodology for developing businesses and products. It aims to shorten product development cycles by adopting a combination of hypothesis-driven experimentation, iterative product releases, and validated learning.

leadership challenge Kouzes and Barry have organized leadership into five evidence-based practices: (1) Model the Way, (2) Inspire a Shared Vision, (3) Challenge the Process, (4) Enable Others to Act, and (5) Encourage the Heart. (see http://www.leadershipchallenge.com/)

leader standard work is, starting with self, developing people to solve problems and improve performance.

lean thinking has three components that build on each other: (1) PDSA, (2) validated learning ("PDSA with a purpose"), and (3) A3 reports (for problem solving, collective impact, or decision quality).

mindfulness is being fully presence without judgment or expectation; it enables moment-by-moment self-awareness and emotional intelligence.

minimum viable product (MVP) In lean startup, the MVP is the "version of a new product which allows a team to collect the maximum amount of validated learning about customers with the least effort" [15].

NewSmart behaviors are (1) Quieting Ego (mindfulness, reflection, minimizing defensiveness and fear), (2) Managing Self (thinking and emotions), (3) Reflective Listening, and (4) Otherness (emotionally connecting and relating) [35].

NewSmart mindset is a measure not of *what* you know or *how much* you know but of (1) the quality of your thinking, listening, collaborating, and learning; (2) how good you are at "not" knowing and decoupling your beliefs (not values) from your ego; (3) how good you are at being open to continually stress-testing your beliefs about how the world works; and (4) how good you are at trying out new ideas and ways to accomplish your objectives and learning from those experiments.

outcomes represent changes in the institutional and behavioral capacities that occur between the completion of outputs and the achievement of goals.

outputs are changes in skills or abilities and capacities of individuals or institutions, or the availability of new products and services that result from the completion of activities within the control of the organization.

pivot In lean startup, a pivot is the decision to change course based your innovation accounting system and actionable metrics.

population health is a systems framework for studying and improving the health of populations through collective action and learning.

population health data science is the art and science of transforming data into actionable knowledge to improve health.

reasoning is short for causal and evidential reasoning. This is the discipline of applying logic and Bayesian reasoning to draw inferences and improve decisions.

results are changes in a state or condition that derive from a cause-and-effect relationship. There are three types of such changes: outputs, outcomes and impact. The changes can be intended or unintended, positive and/or negative.

Results-Based Accountability™ (RBA) is a result-based approached popularized by Mark Friedman [13]. RBA resources are available from http://www.clearimpact.com.

scientific thinking is "a process of deliberately engaging reality with the intent of learning" [26].

standard is a rule or example that provides clear expectations.

standardization is the practice of setting, communicating, following, and improving standards.

standard work (SW) is the agreed-upon, best-known, least wasteful way of doing the work today until a better way is found. SW defines the desired sequence of steps and the time required to perform each step.

theory of action are the ways in which programs or interventions are constructed to activate theories of change; e.g., health promotion programs might use peer mentor, social marketing, or some other strategy to change perceptions of social norms [103].

theory of change are the central processes or drivers by which change comes about for individuals, groups, or communities; e.g., psychological, social, physical, or economic processes. A theory of change can be developed from a formal, research-based theory or an unstated, tacit understanding about how things work [103].

transdisciplinary is a strategy that crosses disciplinary boundaries to create a holistic approach.

validated learning is PDSA cycles with a purposeful or strategic goal. In lean startup, "Startups ... exist to *learn* how to build a sustainable business. This learning can be validated scientifically by running frequent experiments that allow entrepreneurs to test each element of their vision" [15].

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